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GB 243833
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(54) Banknote intaglio printing press

(57) The press includes a plate cylinder 4, and intaglio plate means 9 on the cylinder having ink-receiving recesses separated by smooth surfaces, said plate means 9 extending around less than the entire periphery of the cylinder and having its peripheral ends separated by a gap. Means 10, 11 are provided for applying ink over the smooth surfaces and the recesses, and wiping means 80, 80*a* are arranged for wiping the smooth surfaces of the plate means 9. The wiping means 80, 80*a* include a supply reel for a web for engaging the plate means in wiping contact, a take-up reel for the web, a wiping bar, means for supporting the bar adjacent the cylinder, means defining a path for the web from the supply reel, between the bar and the cylinder, and thence to the take-up reel, and means for advancing the web during the intervals when the bar is adjacent the gap. The press also has a carriage 3 supporting the wiping means and rollable along an underlying surface between an active position in which the web when present may be held by the bar in engagement with the plate means and a retracted position in which the web is spaced from the plate means.

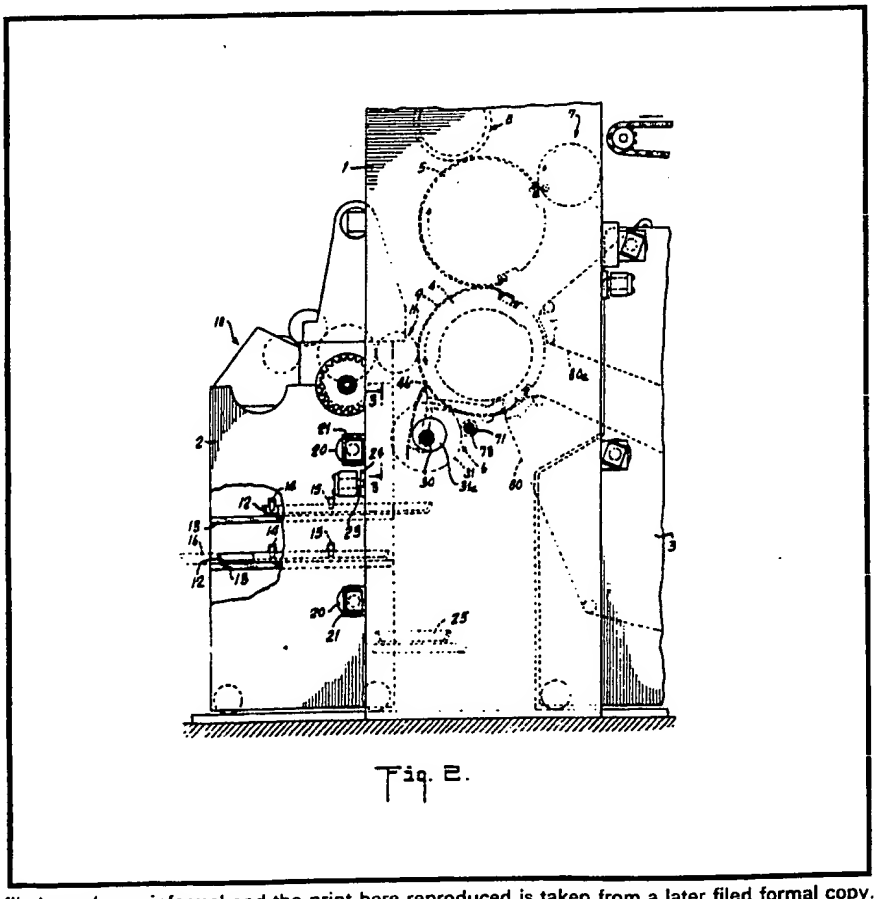

Fig. 2.

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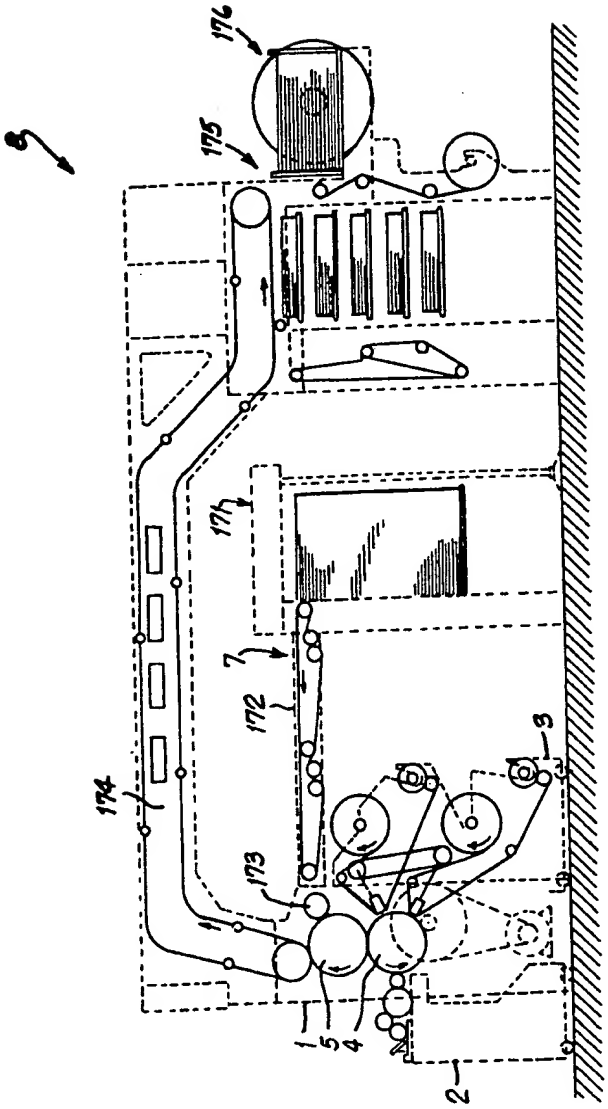

Fig. 1.

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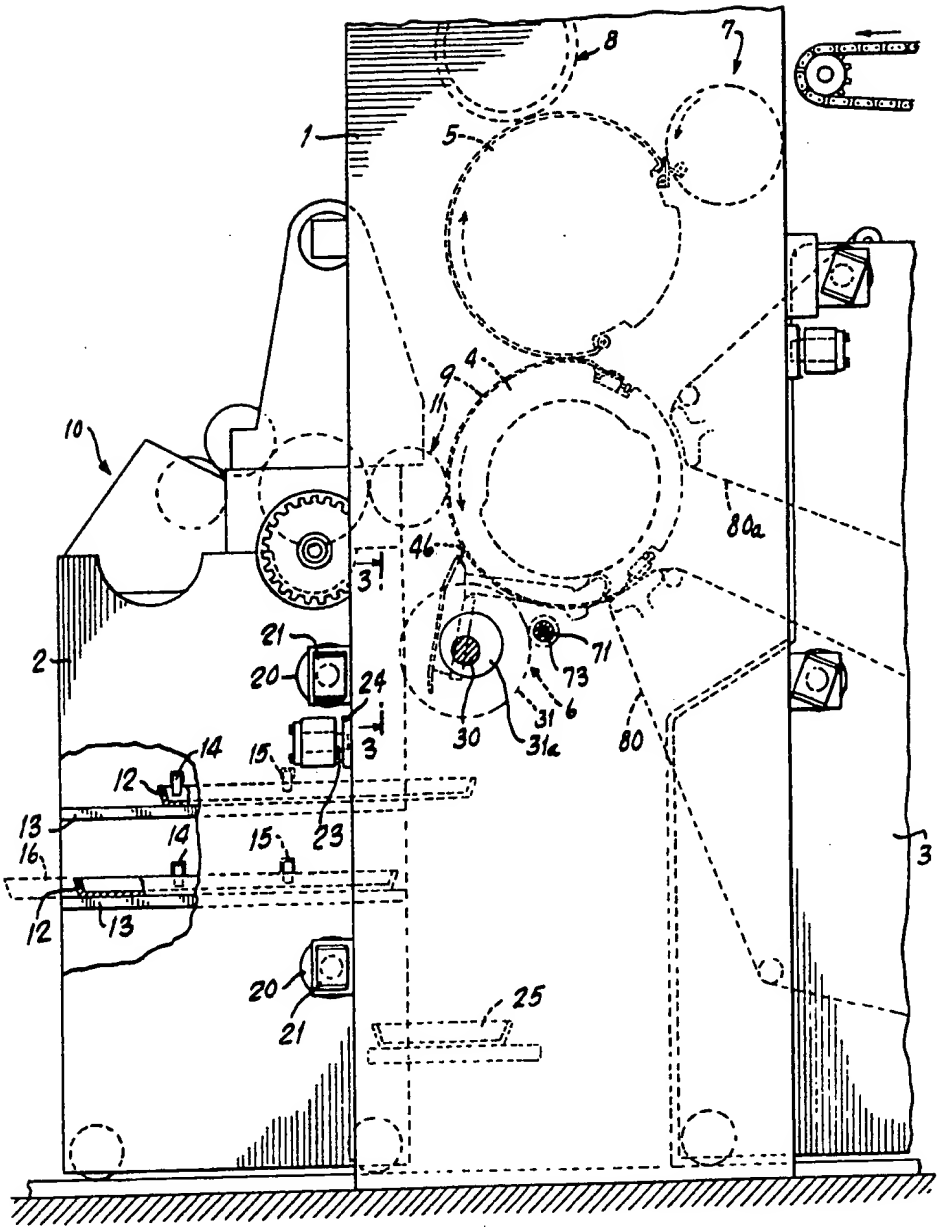


Fig. 2.

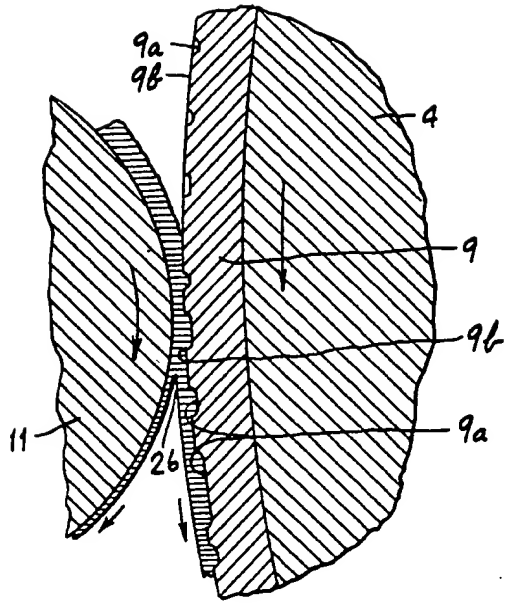


Fig. 2A.
(PRIOR ART)

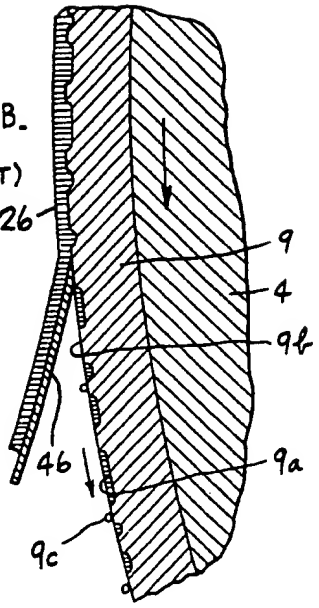


Fig. 2B.
(PRIOR ART)

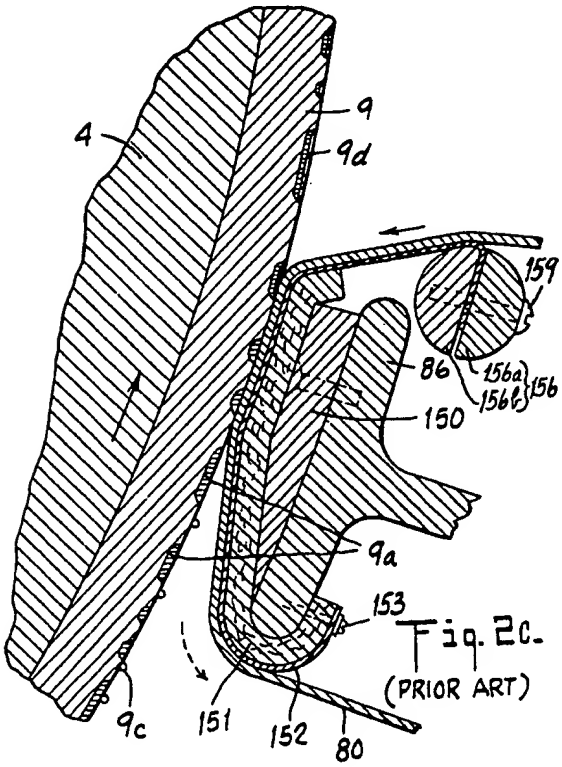
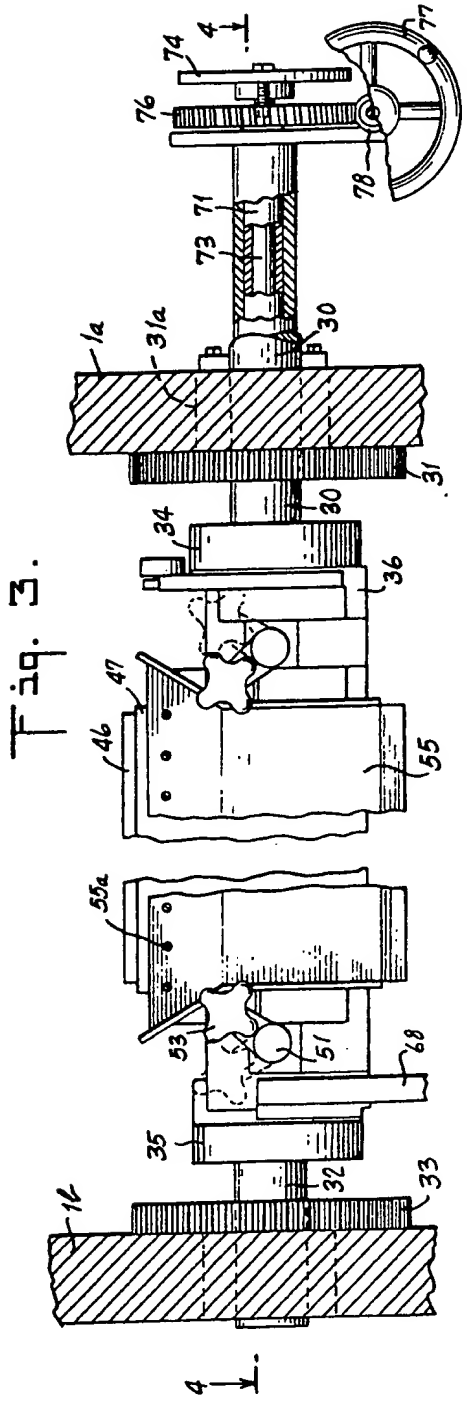


Fig. 2C.
(PRIOR ART)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76
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78
71
73
30
1a
31a
31
34
36
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46
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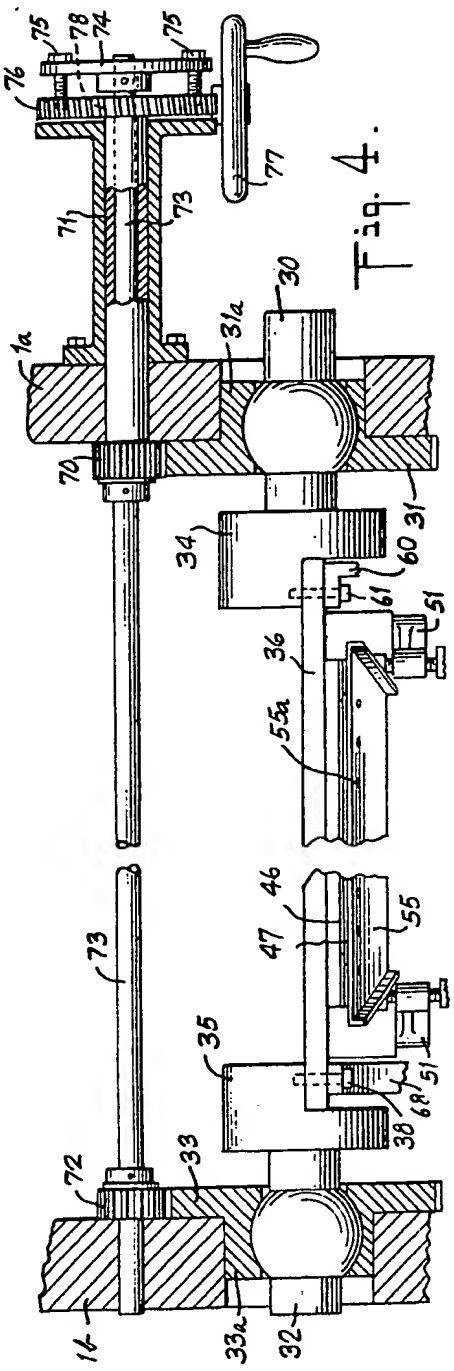
55a
53
51
68
35
32
33
12
4

Fig. 3.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78
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76
77
71
73
30
1a
31a
70
31
34
60
61
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47
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73
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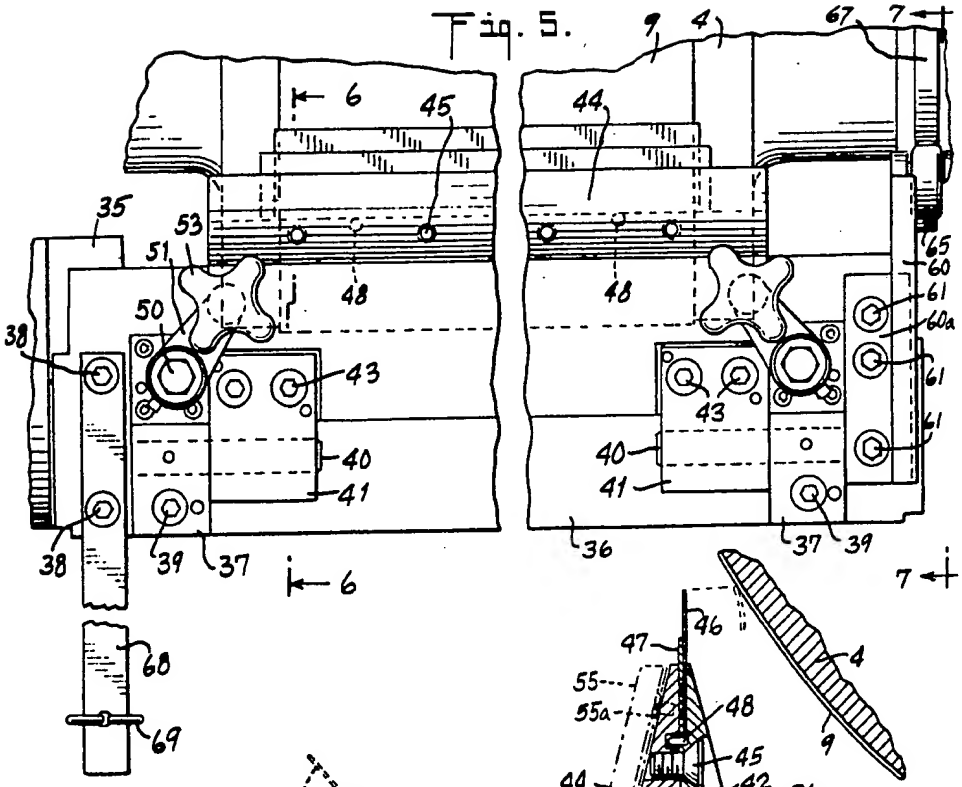
38
72
33
14
33a
32

Fig. 4.

Fig. 5.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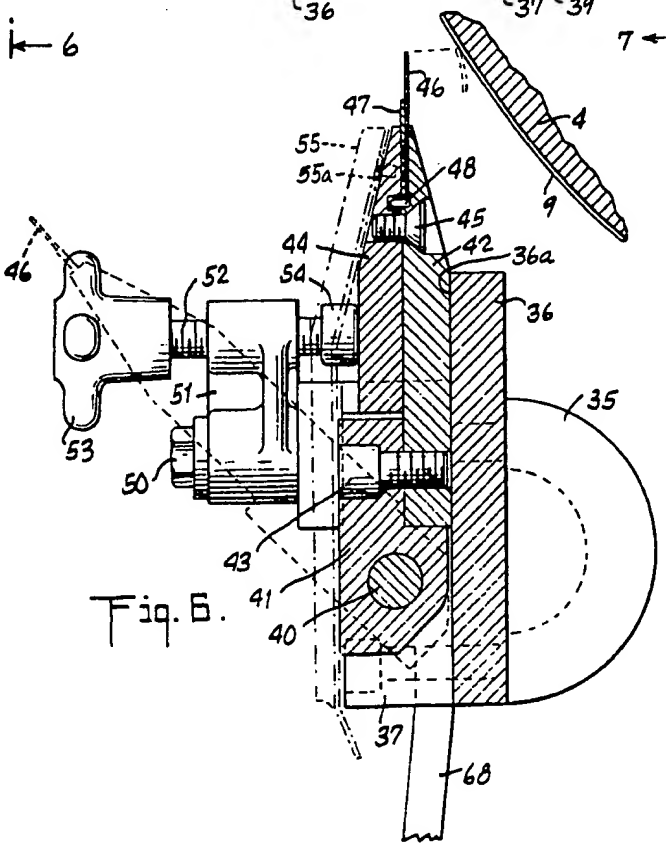
60
61
60a
68
69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55a
48
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36a
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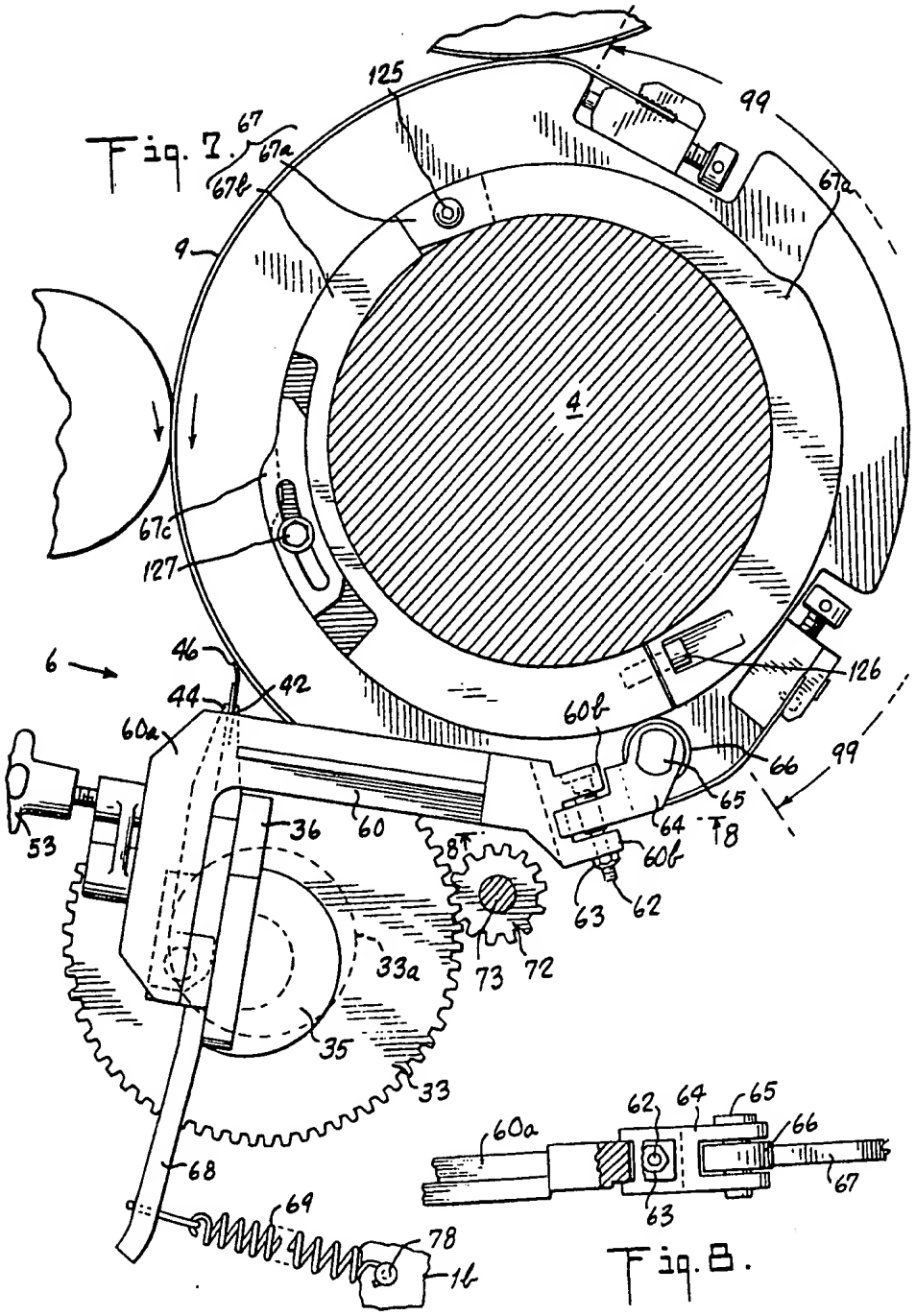
Fig. 6.

Fig. 7.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67a
67b
99
9
4
67c
127
6
46
44
42
60a
60b
126
66
65
64
T8
53
36
60
8
63
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33a
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16

62
64
65
60a
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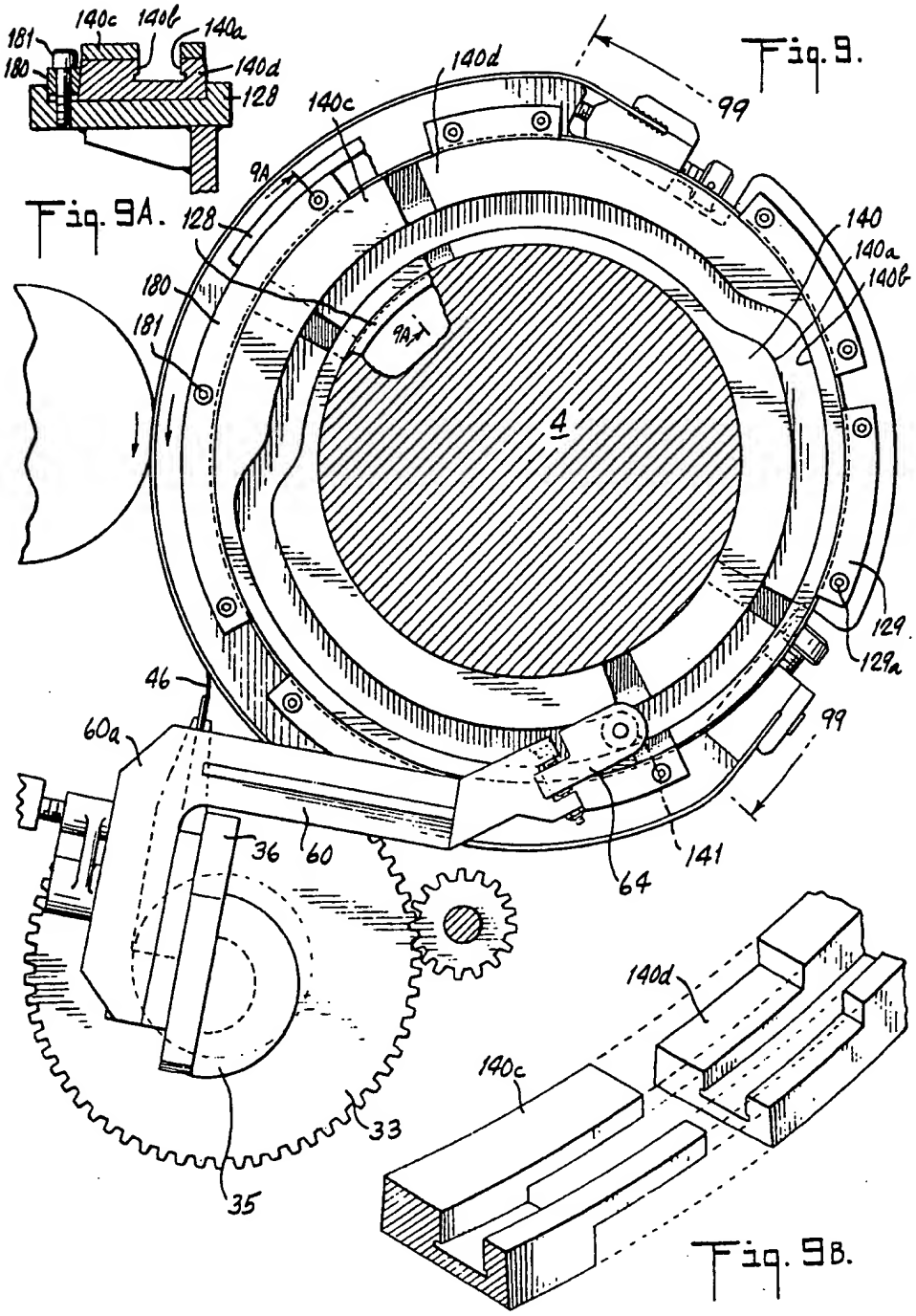
67
63

Fig. 8.


140c
140b
140a
181
180
140d
128
Fig. 9A.
Fig. 9.
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9A
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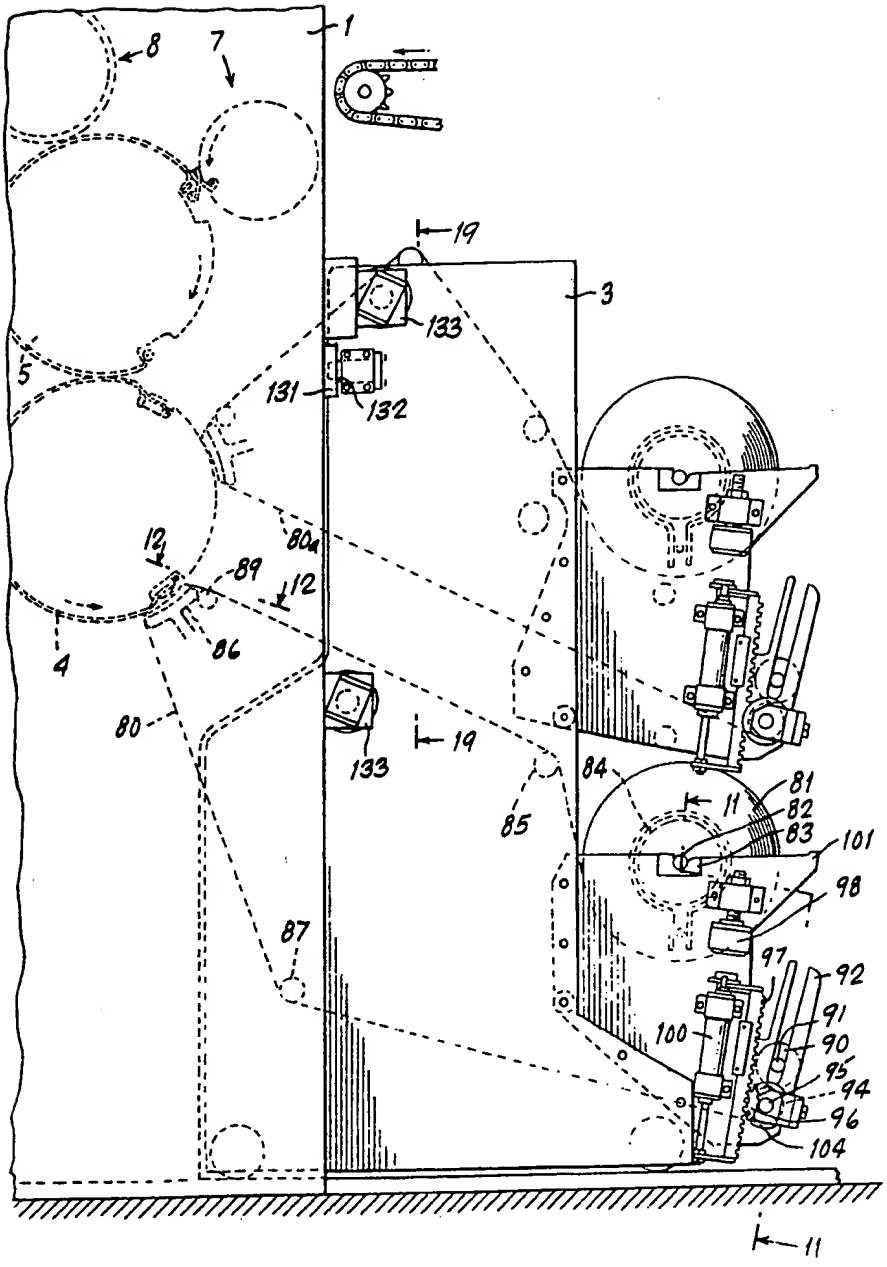
140a
140b
4
129
129a
46
60a
36
60
64
141
33
35
Fig. 9B.


1
8
7
19
3
133
131
132
5
12
80a
89
12
86
4
80
19
133
84
11
81
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11

Fig. 10.

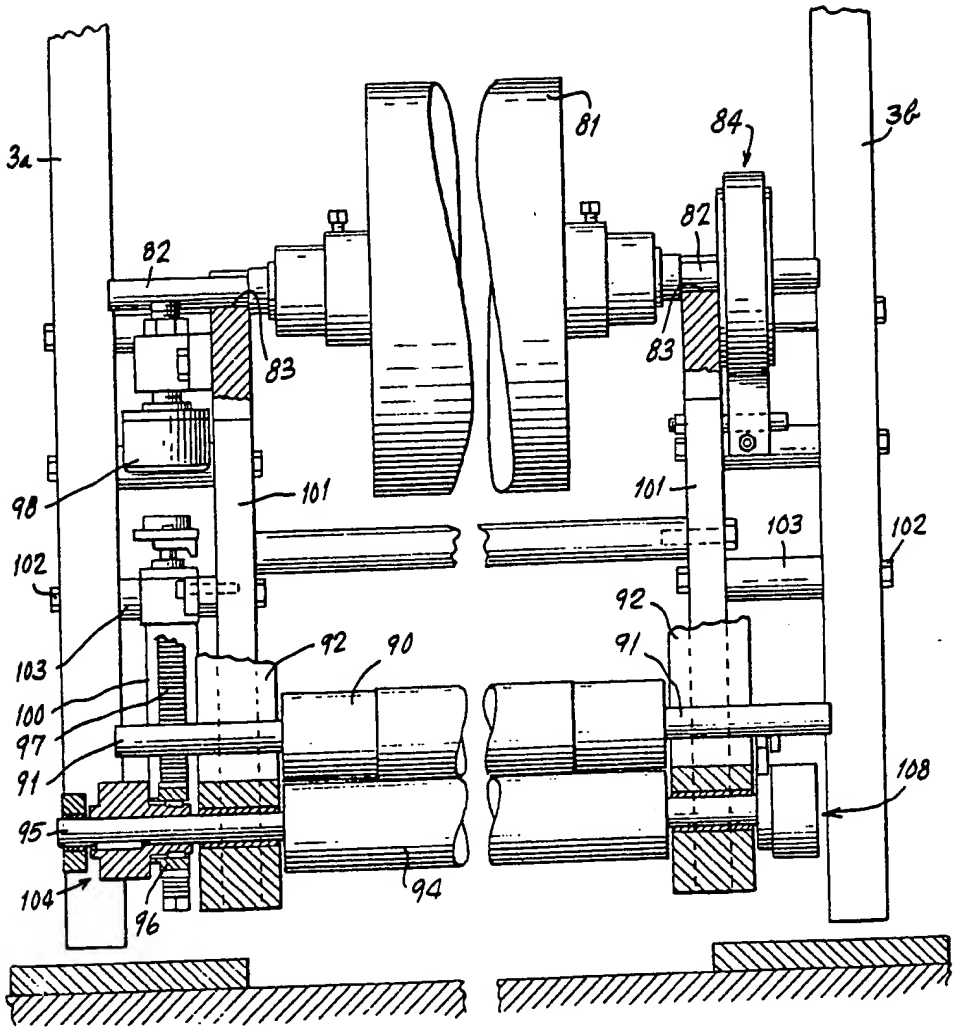
3a
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Fig. 11.

Fig. 12.

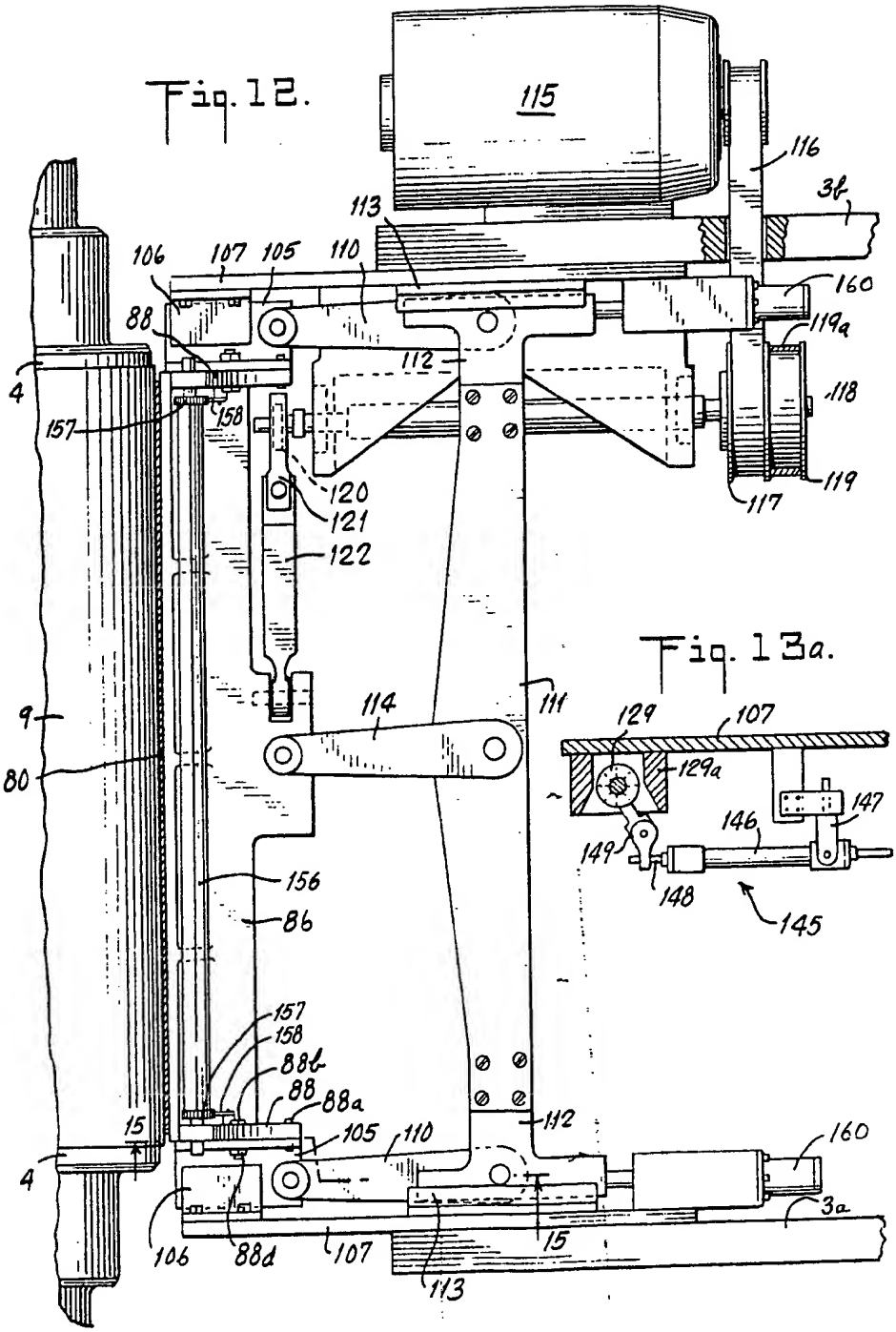
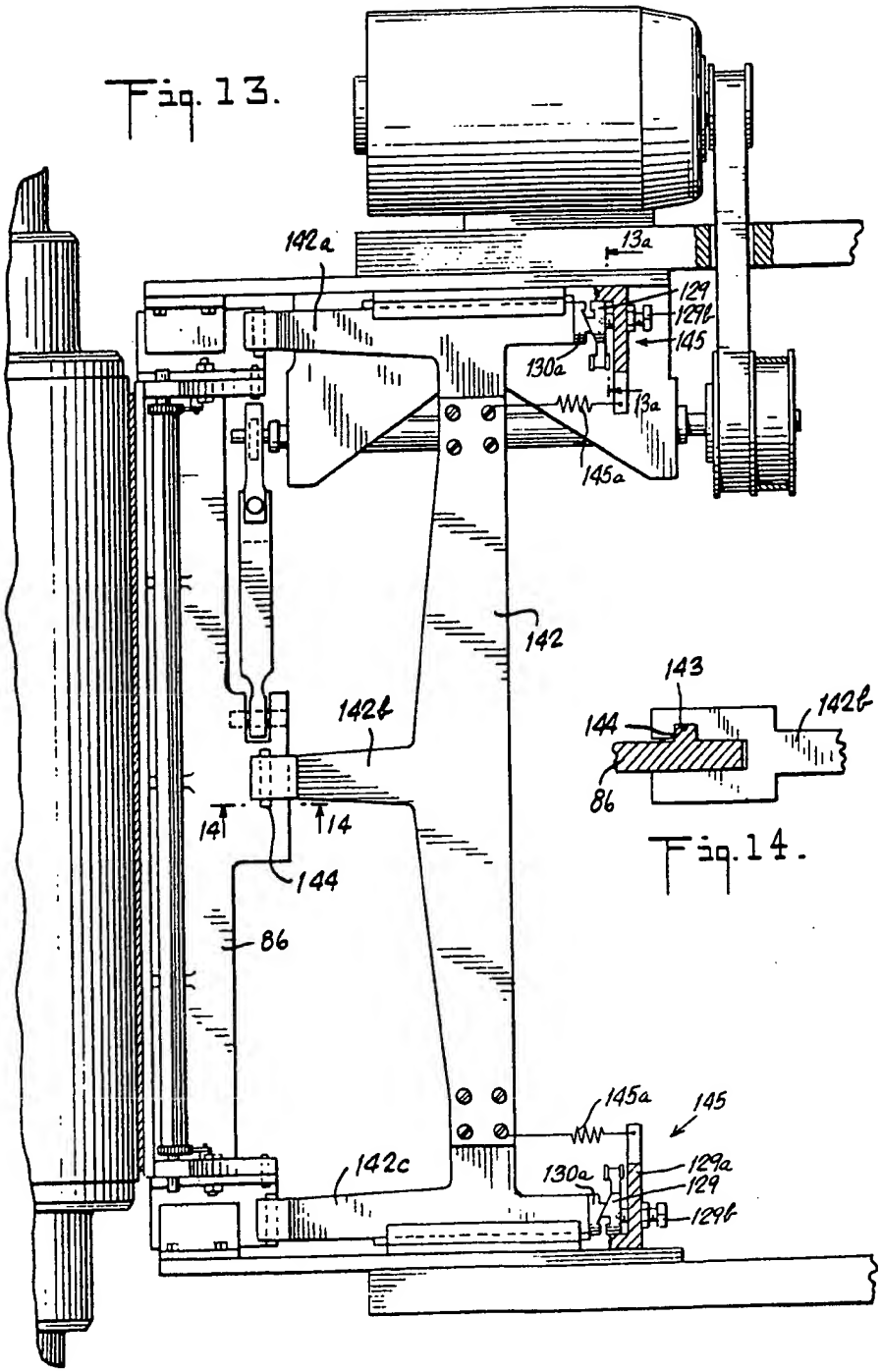


Fig. 13a.

Fig. 13.


142a
13a
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129b
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145a
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142b
14
14
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145
142c
130a
129a
129
129b

143
144
142b
86

Fig. 14.

Fig. 15.

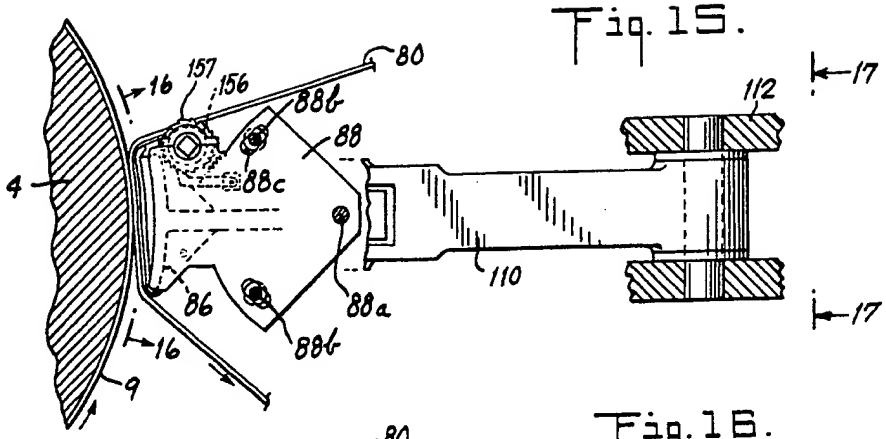


Fig. 16.

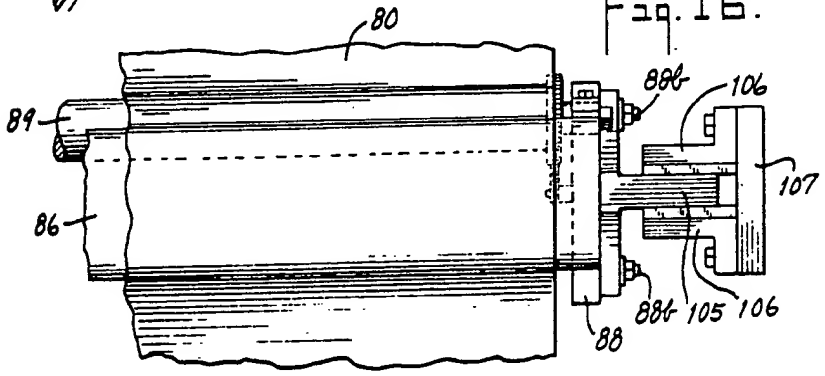
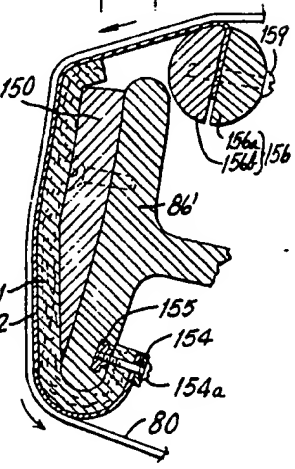


Fig. 18.



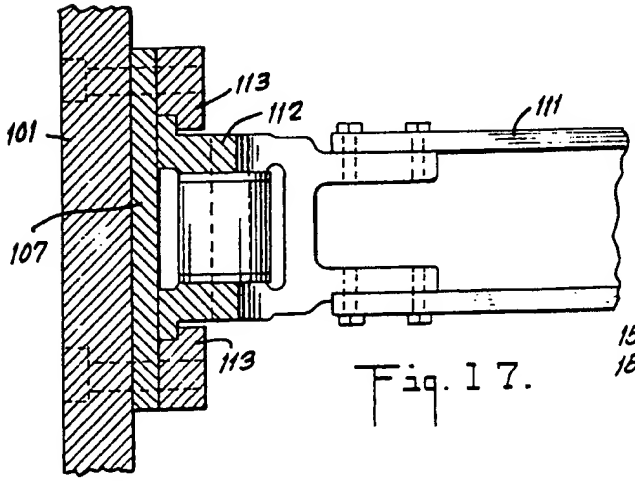


Fig. 17.

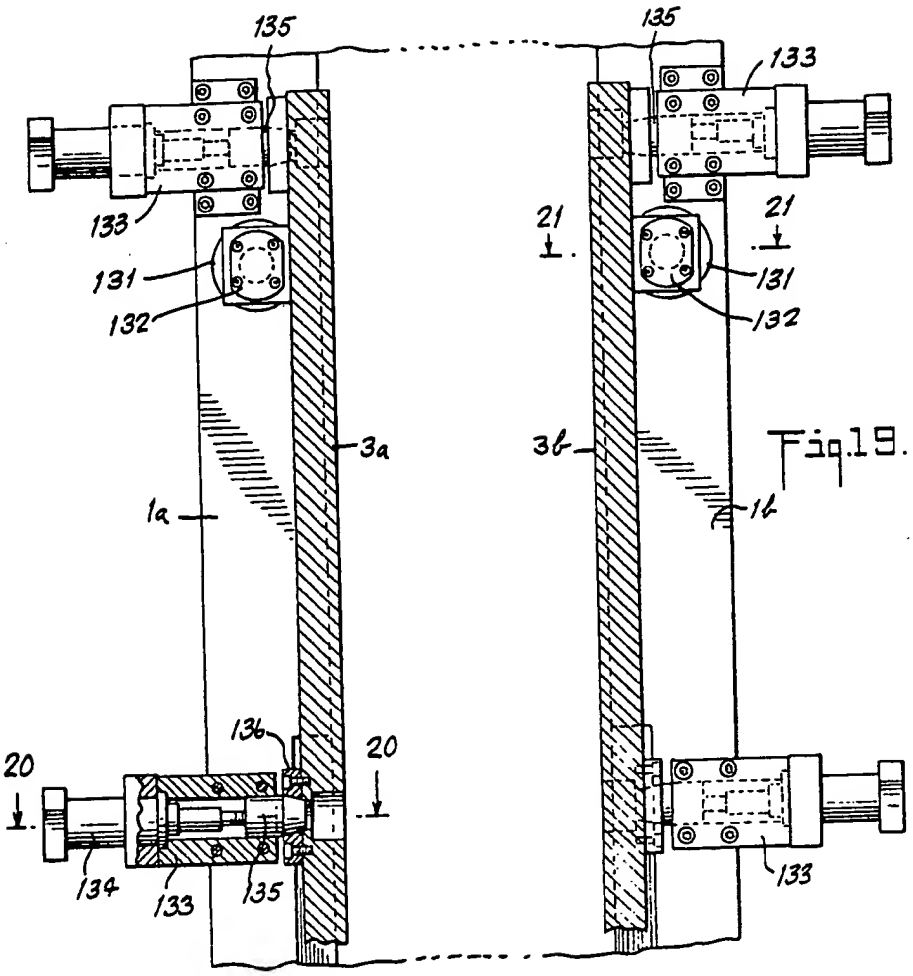


Fig.19.

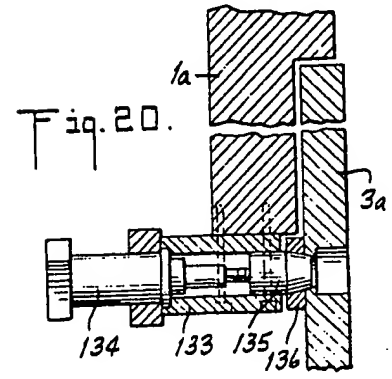


Fig.20.

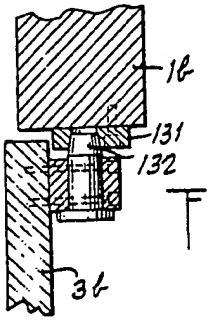


Fig.21.

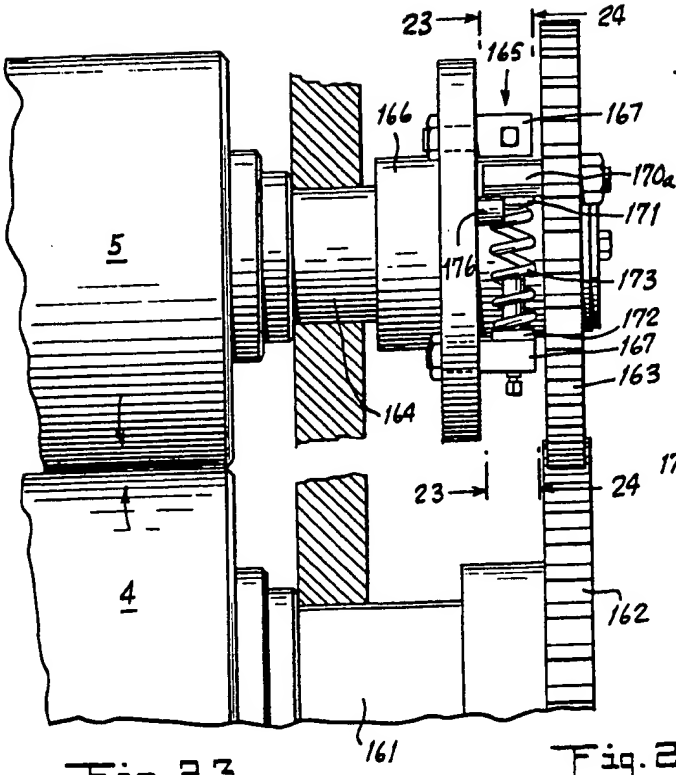


Fig.22.

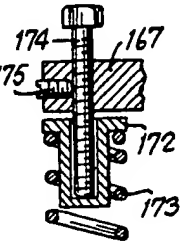


Fig.25.

Fig.23.

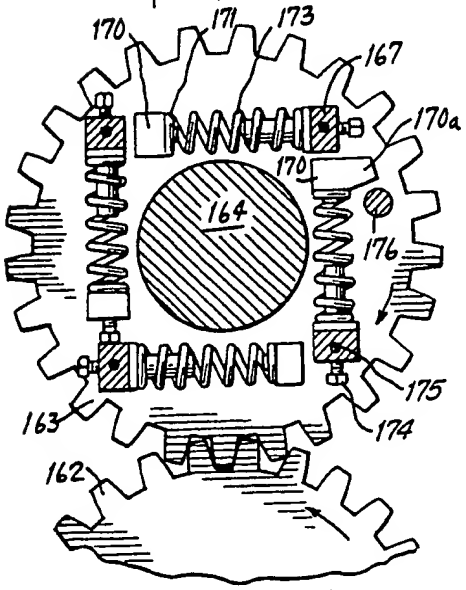
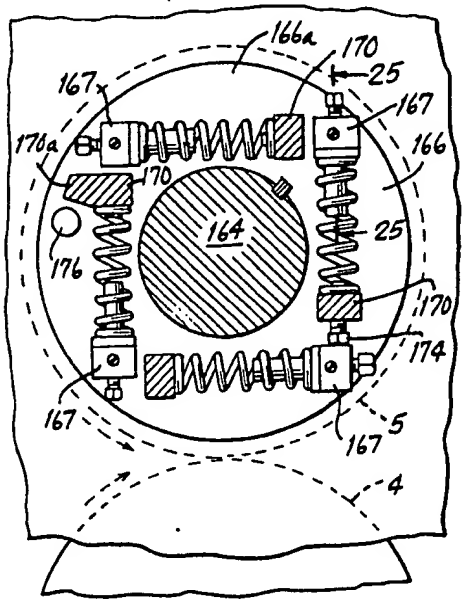


Fig.24.



SPECIFICATION

Banknote intaglio printing press

BACKGROUND OF THE INVENTION

The term "banknote intaglio printing" as used in this specification, is intended to define the type of intaglio printing commonly used to print documents of value and security papers such as banknotes, travelers cheques, etc. In that type of printing, the image to be printed is formed in a printing plate by recesses, which may take the form of either dots or lines, and typically include straight and curved lines longer than 1 mm. (0.39 in.). The recesses vary in depth from 0.0005" to 0.010", and are first filled with ink. The paper is then forced into the recesses and a substantial thickness of ink is built up on the paper, i.e., from 0.0005" to 0.005". This type of printing is carried out with an ink having a viscosity of 50–500 poises at 20°C. The ink is usually heated and worked by a train of rollers to reduce its viscosity before it is applied to the printing plate. It adheres to the plate and to the bottoms of the recesses because of its viscous quality. After being applied to the plate, the excess ink on the surface between the recesses is removed either by a scraper blade and by one or more polishing webs of burlap or absorbent paper, or both. The paper to be printed is then pressed between the inked and polished plate and a pressure roller which is held against the plate with a force (commonly termed a "pressure") of 2000–8000 lbs. per lineal inch.

Other types of intaglio printing, such as those known as "photogravure" or "rotogravure", sometimes shortened to "gravure", use ink-receiving recesses in the form of dots with a surface area of less than 1 square mm. and which approximate circles, although they may be somewhat irregular in contour. They vary in depth up to 0.001". The ink vehicles used are highly volatile and have a viscosity of 1–5 poises at 20°C., and hence are readily flowable. They are applied by flooding the plate with liquid ink. The excess ink between the recesses is removed by a single doctor blade. The printing force is in the range from 20–200 lbs. per lineal inch.

The term "doctor blade", as used herein, defines a blade which makes an acute angle with that part of the cylindrical plate surface which is approaching the line of contact with the blade. The term "scraper blade" is used to define a blade which makes an acute angle with that part of the cylindrical plate surface which is receding from the line of contact with the blade.

BRIEF SUMMARY OF THE INVENTION

The invention is concerned with improved means for removing excess ink from the plate of a banknote intaglio press. The mechanism includes a scraper blade which engages the printing plate immediately after being contacted by the inking roll, and two wiping webs, which engage the plate after it leaves the scraper blade.

A main frame supports a plate cylinder and a pressure cylinder with their axes in vertical alignment and with the pressure cylinder above the plate cylinder. The main frame also supports the scraper blade and the mechanism for operating it. The plate extends for less than the full periphery of the cylinder and the scraper blade must be separated from the cylinder as the gap between the ends of the plate passes the blade. The blade is operated by a cam rotating with the cylinder. The cam forces the blade against the plate when the plate is adjacent the blade. The blade is retracted from the cylinder between the ends of the plate. The retraction may be by a spring or by a tracked cam, which sets positively on the follower in both directions. The force of engagement between the blade and the plate is determined completely by the cam contour and by the resilience of the blade itself. An adjustment is provided in the train of mechanism between the cam follower and the blade. The setting of that adjustment determines the operating position of the blade and hence the force of engagement.

The blade supporting structure is arranged so that the blade may be retracted from the plate for cleaning, or even completely removed, without disturbing the adjustment of the operating position of the blade.

A first auxiliary carriage supports conventional ink supply mechanism and two receptacles for receiving ink collected by the scraper blade. The carriage may be rolled along a suitable track between an operating position in which the ink supply mechanism engages the plate on the plate cylinder and a retracted position in which the plate cylinder is readily accessible. A set of tapered locating pins and mating recesses holds the auxiliary carriage in its operating position against lateral movement with respect to the main frame. A power actuated lock mechanism holds the carriage against movement toward and away from the main frame, and hence holds the locating pins firmly in their recesses.

The wiping webs and their supply and take-up reels are mounted on a second auxiliary carriage on the opposite side of the main frame from the first carriage. Each of the wiping webs proceeds from its supply reel over suitable guides and over a wiping bar against the plate cylinder. The position of the wiping bar determines the force with which the web is held against the plate cylinder. The web then proceeds over suitable quids to a take-up reel provided with an intermittent drive mechanism that advances the web during those intervals when the gap on the plate cylinder is aligned with the wiping bar. The

supply reel is provided with a constant brake to maintain the web under tension and prevent the development of slack in the web. Separate means are provided for adjusting the positions of the opposite ends of the wiping bar with respect to the plate cylinder, and hence the pressure between the wiping bar and the cylinder. As in the case of the first auxiliary carriage, locating pins and a power actuated lock mechanism are provided to hold the second carriage in its operating position. To assist the wiping operation by the web, each wiping bar and the web thereon are reciprocated laterally of the plate cylinder. The locating pins prevent any lateral movement or vibration of the auxiliary carriage with respect to the main frame.

An improved pad is provided on the wiping bar to facilitate the movement of the wiping web between the bar and the printing plate. The pad is constructed for ready replacement.

The second auxiliary carriage may be moved from its operating position to its retracted position without disturbing the pressure adjustment on the two wiping bars. When the carriage is returned to its operating position, the locating pins and the lock mechanism ensure that all parts are restored to their proper operating positions.

The press herein employs a single plate on the plate cylinder. The various novel features of the invention are not limited in their utility to a single plate press. Furthermore, a single plate intaglio press is not new in itself.

A single plate press has several advantages over a multiple plate press in that it is not necessary to make duplicate plates. Hence, the plate cost is substantially lower. Furthermore, the manufacture of exact duplicate plates is, strictly speaking, impossible. Each of two nominally duplicate plates has high and low spots which are not repeated in the other plate. These differences must be corrected on the press by make ready operations which are not necessary on a single plate press. Furthermore, with a single plate, there is no necessity for locating the plates on the cylinder so that they register exactly.

A single plate press presents certain problems not encountered on a multiple plate press. For example, in order for a single plate press to print the same number of sheets per hour as a two plate press, the single plate cylinder must rotate at twice the angular velocity of the two plate cylinder. Vibration problems are therefore increased.

DRAWINGS *Figure 1* is a somewhat schematic view of a press embodying the invention, together with auxiliary equipment such as sheet feeding and delivery mechanisms.

Figure 2 is a fragmentary elevational view of a press embodying the invention, with certain parts broken away and others shown in section.

Figure 2A is a cross-sectional view, on a greatly enlarged scale, illustrating the inking operation at the line of contact between the inking roller and the plate.

Figure 2B is a cross-sectional view on a similar scale, illustrating the operation at the line of contact between the scraper blade and the intaglio plate.

Figure 2C is a cross-sectional view, on a similar scale, illustrating the operation at the area of contact between a wiping web and the intaglio plate.

Figure 3 is a fragmentary sectional view taken on the line 3–3 of Fig. 2, showing the scraper blade.

Figure 4 is a fragmentary sectional view taken on the line 4–4 of Fig. 3, with certain parts broken away.

Figure 5 is a fragmentary view similar to the middle portion of Fig. 3, but on a larger scale, and with a cover removed, showing additional details of the scraper blade and its support.

Figure 6 is a sectional view taken on the line 6–6 of Fig. 5a.

Figure 7 is a sectional view taken on the line 7–7 of Fig. 5.

Figure 8 is a sectional view taken on the line 8–8 of Fig. 7.

Figure 9 is a view similar to Fig. 7, showing a modification.

Figure 9A is a fragmentary sectional view, taken on the line 9A–9A of Fig. 9.

Figure 9B is a fragmentary exploded perspective view, showing how the cam sections of Fig. 9 fit together.

Figure 10 is a fragmentary view showing part of the press in elevation. Figs. 2 and 10 together show the press without the auxiliary sheet feeding and delivery equipment.

Figure 11 is a fragmentary view, partly in section, taken on the line 11–11 of Fig. 10.

Figure 12 is a sectional view taken on the line 12–12 of Fig. 10, on an enlarged scale.

Figure 13 is a view similar to Fig. 12, showing a modification.

Figure 13a is a sectional view taken on the line 13a–13a of Fig. 13.

Figure 14 is a fragmentary cross-sectional view on the line 14–14 of Fig. 13.

Figure 15 is a sectional view taken on the line 15–15 of Fig. 12.

Figure 16 is a fragmentary sectional view taken on the line 16–16 of Fig. 15.

Figure 17 is a sectional view taken on the line 17–17 of Fig. 15.

Figure 18 is a fragmentary sectional view on the line 18–18 of Fig. 12.

Figure 19 is a sectional view taken on the line 19–19 of Fig. 10.

Figure 20 is a sectional view taken on the line 20–20 of Fig. 19.

Figure 21 is a sectional view taken on the line 21–21 of Fig. 19.

Figure 22 is a fragmentary cross-sectional

view, showing a detail of the drive gearing of the plate cylinder and the impression cylinder.

Figure 23 is a cross-sectional view on the line 23–23 of Fig. 22.

Figure 24 is a cross-sectional view on the line 24–24 of Fig. 22.

Figure 25 is a fragmentary cross-sectional view taken on the line 25–25 of Fig. 24.

DETAILED DESCRIPTION

Referring particularly to Figs. 1, 2 and 10, there is shown a printing press including a main frame 1, a first auxiliary carriage 2, and a second auxiliary carriage 3. The press is provided with a sheet feeding mechanism generally indicated at 7 and a sheet delivery mechanism generally indicated at 8. The sheet feeding and delivering mechanisms may be of any suitable conventional construction. The main frame 1 supports a plate cylinder 4, an impression cylinder 5 and a scraper blade mechanism generally indicated at 6, and including a scraper blade 46.

The first auxiliary carriage 2 supports an ink supply mechanism including an ink reservoir 10, and a train of rollers for transferring ink from the reservoir 10 to the plate cylinder and terminating in an inking roller 11 cooperating with a plate 9 on the plate cylinder 4. The ink supply mechanism may be of any suitable conventional type, and includes a means (not shown) for setting the position of inking roller 11 with respect to the carriage 2.

The carriage 2 also supports a pair of ink receiving receptacles 12 which rest on rails 13. Suitable stops 14 are provided to limit the movement of the receptacles 12 toward the press. The upper receptacle 12 is shown close to the stop 14 and is in its ink-receiving position under the scraper blade mechanism 6. A similar pair of stops 15 limits the outward movement of the receptacles 12. After one of the receptacles becomes filled with ink, it may be moved to an unloading position determined by stop 15, in which the receptacle projects outwardly from the carriage 2, as shown in dotted lines at 16 in Fig. 1. This allows the press operator access to the ink in the receptacle 12, so that he may return the ink to reservoir 10. The stop 15 also engages the upper surface of the receptacle 12 and thereby prevents the receptacle from tilting when it is in the unloading position shown at 16. Such a tilt might be occasioned by the weight of the ink in the receptacle, and might cause spilling of that ink. When one receptacle 12 is in its unloading position, the other is advanced to its ink receiving position under the scraper 6 to catch the ink dropped therefrom.

The main frame 1 also supports a set of power operated locks 21 which engage projections 20 on the auxiliary carriage 2 and holds the auxiliary carriage 2 in its operating position, with the ink supply roller 11 engaging the plate on the cylinder 4. A tapered pin 23 is mounted on the carriage 2 and engages a tapered recess formed in a projection 24 fixed on the frame 1. When the carriage is in its operating position, the pin 23 holds the carriage 2 against lateral movement (perpendicular to the plane of the drawings) with respect to the main frame 1 during operation of the press. The locks 21 hold the carriage against longitudinal movement from its operating position, and thereby hold the pin 23 in its recess.

The locks 21 and the pins 23 are similar in structure and function to the locks 133 and pins 132 described in detail below in connection with Figs. 19–21.

Another ink receptacle 25 is supported on the main frame below the scraper 6 and serves to collect ink falling from the scraper blade after the carriage 2 has been moved to its retracted position.

The second auxiliary carriage 3 supports a wiping web 80 and a polishing web 80a and their related mechanisms, as described more completely below in connection with Figs. 10–18.

FIGS. 2A–2C

These figures illustrate, on an enlarged scale, the operation of the mechanism for applying ink to the intaglio plate 9 and the operation of the scraper blade 46 and the wiping web 80 for removing the excess ink.

The operations illustrated in these figures are typical of banknote intaglio printing presses, including prior art presses as well as the press of the present invention. These illustrations show explicitly the operations in banknote intaglio presses which distinguish them from corresponding operations in other types of intaglio presses, e.g., rotogravure.

Referring to Fig. 2A, it may be seen that the intaglio plate 9 has on its printing surface ink-receiving recesses 9a (representing dots or lines to be printed) separated by smooth surfaces 9b. At the inking roller 11, there is deposited on the plate 9 a layer of ink generally indicated at 26, which fills the recesses 9a and also covers the surfaces 9b between those recesses.

Scraper blade 46, as may be seen in Fig. 2B, scrapes most of the ink of the layer 26 from the smooth surfaces 9b and leaves the recesses 9a filed with ink. A few droplets 9c of ink remain on some of the smooth surfaces, which are not completely cleaned by the blade 46.

In Fig. 2C it may be seen that the wiping web 80 engages the plate 9 with increasing pressure toward the trailing edge of the web 80. Its effect is to remove almost all of the droplets 9c and to form a shallow meniscus 9d in the ink at each of the recesses 9a.

The second web 80a performs a similar function to the web 80, although it is com-

monly referred to as a polishing web, whereas the first web 80 is called a wiping web. The plate 9 is cleaner as it approaches the second web 80a, so that there is less ink to be removed by that web.

SCRAPER BLADE MECHANISM–FIGS. 3–9

The scraper blade mechanism indicated generally at 6 in Fig. 2 is shown in detail in Figs. 3–9. The scraper blade mechanism is supported in two uprights 1a and 1b of the main frame 1. A stub shaft 30 is journaled eccentrically by means of a spherical bearing in the hub 31a of a gear 31. The hub 31a is journaled in the upright 1a. Another stub shaft 32 is journaled eccentrically by means of another spherical bearing in a hub 33a of a gear 33. The hub 33a is journaled in the upright 1b. The two hubs 31a and 33a are horizontally aligned. When the two hubs 31a and 33a have the same angular positions, the stub shafts 30 and 32 are also horizontally aligned. The stub shafts 30 and 32 carry at their inner ends a pair of blocks 34, 35 having flat surfaces on which a datum member 36 is mounted by means of screws 38 and 61.

A pair of pads 37 (Fig. 5) are attached to the datum members 36 at the opposite ends thereof by means of screws 39. Each pad 37 supports a pivot pin 40. A pair of arms 41 are rotatably mounted on the pins 40 and project upwardly therefrom as seen in Figs. 5 and 6. Each arm 41 supports a first jaw 42 by means of a pair of screws 43. A second jaw 44 is held to the first jaw 42 by means of screws 45. The jaws 42 and 44 are formed at their upper facing margins with recesses for receiving the lower margin of a scraper blade 46 and a stiffener plate 47. The scraper blade 46 is of resilient, wear resistant material, and may be 0.008" thick. The plate 47 is of thicker, more rigid material, and may be 0.020" thick.

Two locating pins 48 are fixed in or integral with the jaw 42 and extend into matching apertures in the jaw 44. The pins 48 span the recesses in which the blade 46 and plate 47 are received and thereby locate the bottom edges of blade 46 and plate 47. This construction facilitates accurate location of the blade 46 and plate 47, since only the upper surfaces of the pins 48 need to be accurately machined.

Each pad 37 also supports a screw 50 serving as a pivot pin for a locking arm 51. The end of the arm 51 threadedly receives a screw 52 whose outer end is provided with a hand wheel 53 and whose inner end is provided with a shoe 54. In the full-line positions shown in the drawings, the shoes 54 abut the jaw 44 and lock the jaw 42 against a datum surface 36a of the datum member 36 and thereby fix the position of the blade 46 with respect to the centers of the shafts 30 and 32. When it is desired to retract the blade 46 for cleaning or replacement, the hand wheels 53 are rotated to loosen the shoes 54 and the arms 51 are rotated to the dotted line positions shown in Fig. 3 to move the shoes 54 out of alignment with the jaws 44. The jaws 44, 42 may then be turned with the arms 41 on the pins 40 to the retracted positions shown in dotted lines in Fig. 5, so that the blade 46 may be readily cleaned. When the jaws 42 and 44 are in their retracted positions, the screws 45 may be loosened to separate the jaws for replacement of the blade. After the blade 46 is cleaned or possibly replaced, it may be returned to its operating position by tightening the screws 45, rotating arms 41 back up to their operating positions and locking the jaw 42 against the datum surface 36a by means of the hand wheels 53 and screws 52.

A cover 55 is fixed on the jaw 44 by screws 55a and protects the scraper supporting and operating mechanism from ink falling from the blade 46. The cover 55 moves with the jaw 44 during blade cleaning and replacement operations.

An arm 60 has a flanged extension 60a which is fixed on the datum member 36 by means of screws 61. See Figs. 5 and 7. The arm 60 is forked at its end, as shown at 60b. A bolt 62 is rotatably received in the tines of the forked end 60b. A lock nut 63 holds the bolt 62 against rotation. A follower carrier 64 is threaded on the bolt 62 and is forked at its end to embrace the arm 60. The carrier 64 supports a shaft 65 which rotatably carries a follower roller 66 cooperating with a cam 67 fixed on the hub of the plate cylinder 4.

When the parts are in the positions shown in Fig. 7, the cam 67 has forced the roller 66 outwardly, thereby rotating the hubs 31a, 33a and forcing the jaws 42, 44 into a position where the blade 46 yieldably engages the plate 9 on the plate cylinder 4. The blade is laterally deflected by that engagement as shown in Fig. 7. Note that there is no resilient part in the train of mechanism between the roller 66 and the blade 46. Hence, the operating position of the blade 46 and the amount of its deflection is determined solely by the setting of the follower carrier 64 on the bolt 62. The force developed at the line of contact between the blade 46 and plate 9 is determined by the blade position and the resilience (i.e., the spring rate) of the blade.

Retraction of blade 46 to the dotted line position of Fig. 6 for cleaning or replacement does not disturb the setting of carrier 64 on bolt 62. Restoration of the jaws 42 and 44 to their operating positions by means of hand wheels 53 also restores the blade 46 to its previously set operating position.

After the roller 66 has been set, the positions of the ends of the blade 46 may be adjusted independently or together toward or

away from the plate 9 by a mechanism for rotating the gears 31 and 33 together or gear 31 alone. (Figs. 3 and 4). The gear 31 meshes with a pinion gear 70 fixed on a sleeve 71 journaled in the upright 1a. The gear 33 meshes with another pinion gear 72 fixed on a shaft 73. Shaft 73 is concentric with the sleeve 71 and extends through it. A disc 74 is fixed on the right-hand end of shaft 73, as viewed in Figs. 3 and 4. Disc 74 is connectable by means of screws 75 to a worm gear 76 fixed on the sleeve 71 and rotatable by means of a worm 78 driven by a hand wheel 77. When the screws 75 are tightened to connect disc 74 to the gear 76, rotation of the hand wheel 77 turns both the pinions 70 and 72 concurrently and adjusts both ends of the blade 46. When the screws 75 are loosened to disconnect the disc 74 from the gear 76, then rotation of the hand wheel 77 turns the pinion 70 but not pinion 72 and thereby adjusts only the right-hand end of the blade 46 as viewed in Fig. 3. The spherical bearings in the hubs 31a and 33a allow the stub shafts 30 and 32 to tilt as required to accommodate this independent movement of the ends of blade 46. By appropriately adjusting the positions of the ends of the blade, the deflection of the blade may be made uniform throughout its length.

An arm 68 is attached by screws 38 to the datum member 36 at its left-hand end as seen in Fig. 5. A spring 69 (Fig. 7) connects the lower end of the arm 68 to an anchor pin 78 on the upright 1b. The spring 69 biases the datum member 36 to a position where the blade 46 is retracted from the surface of the plate 9 as shown in full lines in Fig. 6. This retraction is accomplished by spring 69 every time the follower roller 66 moves into the low portion of the cam 67. This takes place whenever the blade 46 is in the gap between the ends of the plate 9. When the blade 46 reaches the leading margin of plate 9, the cam 67 forces the blade back into scraping contact with the plate.

The cam 67 is made in two semicircular sections 67a and 67b. The sections 67a and 67b are connected at one end by a hinge pin 125 and fastened together at their opposite ends by a screw 126 which threadedly engages the section 67b and has its head received in a recess in the section 67a. The section 67b is provided with a circumferentially adjustable slotted section 67c by which the peripheral length of the high portion of the cam 67 may be adjusted. Section 67c is connected to section 67b by a bolt 127. The cam 67 may be rotated bodily on the cylinder 4 by releasing the screw 126 so as to separate the sections 67a and 67b slightly and allow the whole cam structure to turn on the cylinder. The circumferential position of the riser portion 67a is adjusted in that manner. The drop off portion of the cam is determined by the position of the adjustable section 67c, which may be moved circumferentially of the section 67b by releasing the bolt 127 and sliding the section 67c to the desired position. In this manner, the angular position of the plate cylinder 4 where the blade 46 engages the plate and the position where it is lifted from the plate may be adjusted.

Fig. 9

This figure illustrates a modification of the cam and follower structure shown in Fig. 7. The cam 67 of Fig. 7 is replaced in Fig. 9 by a tracked cam 140 having opposed cam surfaces 140a and 140b. The follower 66 of Fig. 7 is replaced by a follower 141. The follower 141 is positively driven by cam 140 in both directions. The blade 46 is thereby positively lifted away from plate 9 at the beginning of the gap 99 and is positively forced into engagement with the plate 9 at the end of gap 99.

The cam 140 includes two overlapping angularly adjustable sections, shown at 140c and 140d, each somewhat longer than a semicircle. Each of the sections 140c and 140d has its radially inner and outer sides beveled, as best seen in Fig. 9A, and is received in a supporting channel member 128, which is mounted on the plate cylinder 4. The channel member 128 has the radially inner side of its channel undercut, to match the bevel on the sections 140c and 140d. The outer sides of the sections 140c and 140d are held in the channel member 128 by a plurality of arcuate wedges 180, which are held on the channel member 128 by screws 181. The wedges 180 have their radially inner surfaces beveled to match the outer sides of the sections 140c and 140d. The position of either section 140c or 140d may be adjusted by loosening the appropriate screws 181. Thus, the angular positions of the plate cylinder 4 where the blade 46 first engages the plate and where it separates from the plate may be independently adjusted with the cam structure of Fig. 9. In the structure of Fig. 7, any adjustment of the angular position of the riser section 67a necessarily entails a concomitant adjustment of the drop-off section 67b, which thereafter has to be adjusted to compensate for the movement introduced by the adjustment of the riser 67a. The cam adjustment structure of Fig. 9 is therefore an improvement over the cam structure 67 in that that compensating adjustment does not have to be made.

The positive forcing of the cam into engagement with the plate is common to the modification of both Figs. 7 and 9. The positive drive of the blade 46 away from the plate at the gap 99 as in Fig. 9, follows the action of the press more closely under high speed conditions than does the spring-driven retraction of the blade as in Fig. 7.

Arm 68 of Fig. 7, being unnecessary in the modification of Fig. 9, is omitted in that figure. The other parts in Fig. 9 are the same as their counterparts in Fig. 7 and have been identified with the same reference numerals.

THE WIPING WEB–FIGS. 10–18

The first of the two wiping webs encountered by the plate cylinder 4 as it rotates is shown at 80 in Fig. 10. The second wiping web, sometimes termed a polishing web, is shown at 8a. Since the two webs and their associated mechanism are essentially duplicates, only the wiping web 80 and its mechanism will be described in detail.

The web 80, which may be of crepe paper, burlap or the like comes from a supply reel 81 turning on a shaft 82 supported by trunnions 83. The reel 81 is provided with an adjustable brake 84, of any suitable construction, which maintains the web under tension. The web proceeds from the reel 81 over a guide roller 85, a padded wiping bar 86 and thence between the wiping bar 86 and the plate cylinder 4. It then passes over another guide roller 87 and a drive roller 94 to a take-up reel 90 on a shaft 91 which rotates in a pair of slotted guides 92. The take-up reel 90 is supported on the drive roller 94, which is fixed on a shaft 95 carrying a pinion 96. The pinion 96 is driven by a rack 97 operated by a hydraulic reciprocating motor 100. An adjustable stop 98 limits the stroke of the reciprocating motor 100.

The hydraulic motor 100 is controlled by a cam (not shown) operating concurrently with the plate cylinder 4 and driving a follower operating a valve effective to supply hydraulic fluid to the motor 100 to advance the web 80 during those intervals when the gap 99 (Fig. 7) between the ends of the plate 9 is opposite the wiping bar 86. At that time, the web 80 passing over the wiping bar 86 is not in contact with the cylinder 4, and is free to move.

The trunnions 83 are formed in a pair of plates 101 mounted on the side plates 3a and 3b of the carriage 3 by means of bolts 102 and spacers 103. The pinion 96 is connected to the shaft 95 through a suitable conventional one-way clutch mechanism shown at 104, so that the return stroke of the rack cannot reverse the direction of rotation of shaft 95 and the take-up reel 90. Another one-way clutch 108 is located at the other end of shaft 95, and permits it to turn in only one direction with respect to the plate 101.

The wiping bar 86 is reciprocated laterally of the press by means of an apparatus illustrated in Figs. 12–17. The bar 86 is attached at its ends to plates 88 which are mounted on a pair of sliders 105 of T-shaped cross-section (Figs. 12 and 16). Each slider has a stem of its T-shaped cross-section supported between a pair of angle irons 106 mounted on beams 107 attached to the side plates 3a and 3b. The sliders 105 are pivotally connected to a pair of links 110 whose opposite ends are pivotally connected to a beam 111 extending transversely of the press and supported at its ends on a pair of shoes 112 slidably received between upper and lower guide rails 113 (Figs. 12 and 17) fixed to the beam 107 and thereby to plates 3a, 3b. Another link 114 is pivotally connected at its ends to the middle of the wiping bar 86 and to the middle of the beam 111. It may be seen that the beam 111, the bar 86 and the links 110 and 114 constitute a parallelogram linkage which allows the bar 86 to be oscillated laterally with respect to the frame 3a, 3b of the carriage 3. That oscillation is produced by a motor 115 (Fig. 10) driving a belt 116 that in turn drives a pulley 117 carried by a shaft 118 journaled in the beam 111. The other end of the shaft 118 drives an eccentric 120. An arm 121 receives the eccentric 120 and is pivoted on one end of a link 122 whose opposite end is pivotally connected to the bar 86. Thus, as the motor 115 turns, it oscillates the bar 86 laterally, thereby enhacing the wiping action of the web 80.

The shaft 118 carries a second pulley 119 driving a belt 119a which supplies power to the oscillating mechanism of the second web 80a. The two oscillating mechanisms should be operated 180° out of phase with each other to minimize vibration of the auxiliary carriage 3.

The beam 111 may be advanced toward and away from the plate cylinder 4 by means of two hydraulic cylinders 160, which may act selectively either to apply pressure between the web 80 and the printing plate 9 or to relieve that pressure.

Wiping bar 86 is supported at its ends on plates 88. Each plate 88 is mounted for limited pivotal adjustment on one of the sliders 105. See Figs. 15 and 16. Each mounting includes a pivot pin 88a fixed in the slider 105 and on which the plate 88 is rotatable. A pair of bolts 88b are also fixed in the slider 105 and are received in slots 88c in the plate 88. The angular position of the plate 88 may be varied with respect to the plate cylinder 4 by loosening nuts 88d on the bolts 88b so that plate 88 may be pivoted on the pin 88a.

By means of this angular adjustment of the plate 88, the pressure between the leading edge of the bar 86 and plate cylinder 4 may be made greater or less than the pressure between the trailing edge of the bar 88 and the plate cylinder 4. It is commonly desired to produce the greatest pressure at the trailing edge, since the quantity of excess ink reaching the trailing edge is less than that present at the leading edge.

FIGS. 13–14

These figures illustrate a modification of the

apparatus in Fig. 12, in which the parallelogram linkage 110, 111, 114 and 86 is replaced by a straight line travel mechanism including a beam 142 having fixed projecting arms 142a, 142b and 142c. Each of these arms, as illustrated in Fig. 14 in the case of arm 142b, has a forked end which straddles a portion of the wiper bar 86. The upper fork of each arm has a downwardly facing slot 143 in its under surface, which receives an upwardly projecting ridge 144 on the wiper bar 86. As the wiper bar 86 is oscillated, the ridges 144 reciprocate in the slots 143.

The wiper bar 86 may be driven toward the plate cylinder 4 to establish the desired wiping pressure between the web 80 and the plate 9, by means of two driving mechanisms 145, one acting on each end of the beam 142. One of the driving mechanisms 145 is shown in detail in Fig. 13a. The driving mechanism 145 includes a hydraulic cylinder 146 pivotally mounted on trunnions 147 supported on the beam 107. The cylinder 145 drives a piston rod 148 connected by a jointed arm 149 to a rotatable helical wedge 129 journaled in a bracket 129a and cooperating with another helical wedge member 130 fixed on a shoe 130a integral with arm 142a and sliding between guide rails 113 in the same manner as shoe 112 of Fig. 12. Application of hydraulic fluid under pressure to the cylinder 146 drives the helical wedge 129 in a direction to force the beam 142 toward the cylinder 4 and thereby to establish the desired wiping pressure at a web 80. The helical wedge 129 has a fixed angle of rotation in response to the fixed travel of the piston rod 148. The active position of the end of wiping bar 86 is set by adjusting a screw 129b on the bracket 129a. The inner end of screw 129b has a reduced diameter extension which serves as a pivot for wedge 129.

Bracket 129a is fixed on the beam 107. A pair of springs 145a are connected in tension between the ends of the beam 142 and the brackets 129a. These springs are effective when the hydraulic pressure is relieved in the cylinder 146 to restract the beam 142 and thereby relieve the pressure between the web 80 and the printing plate 9.

The ends of the arms 110 and 114 in Fig. 12 move in an arc as the wiper bar 86 is oscillated, so that the pressure between the wiper bar 86 and the plate cylinder 4 is reduced slightly at the end of the wiper bar travel. The straight line mechanism of Fig. 13 eiliminates this reduction of pressure at the ends of the wiper bar travel, so that the wiper bar maintains a fixed pressure against the plate cylinder at all parts of its stroke.

WIPER BAR PADDING ASSEMBLY–FIGS. 2C AND 18

The wiper bar 86 has fixed on its surface opposed to the plate cylinder 4 a wedge 150. In Fig. 2C, a resilient pad 151 covers the wedge 150 and extends beyond the upper edge of the wedge and beyond the lower edge of the wiper bar 86. The pad 151 is compressed and held in place by a cover 152 of any suitable wear resistant plastic material. The pad 151 and the cover 152 are held in place on the wiper bar 86 by means of a row of screws 153 extending through the lower margins of the pad 151 and cover 152, and threaded into a bar 86.

The upper margin of the cover 152 is clamped between the two semicylindrical halves 156a, 156b of a take-up bar 156. The semicylindrical half 156a of the bar 156 carries at its end a pair of ratchets 157 (Fig. 12), and has projecting pivots journaled in the plates 88. The ratchets 157 cooperate with pawls 158 mounted on the plates 88. The semicylindrical half 156b of the bar 156 is fastened to the semicylindrical half 156a by means of screws 159. When installing the pad assembly, the lower margin of the cover 152 and pad 151 are first attached to the bar 86 by means of the screws 153. The pad and cover are then wrapped around the bar and the upper margin of the cover 152 is clamped between the halves of the bar 156. The bar is then rotated to tighten the cover 152 and compress the pad 151. The ratchets are effective to hold the bar in its pad-compressing position.

The wedge 150 ensures that the pressure between the cover 152 and the plate 9 increases gradually from zero at the leading edge of the wiper bar, and is greatest at the trailing margins of the wiper bar. The padding assembly of Fig. 2C is known in the art.

Fig. 18 shows an improved, readily replaceable cover pad assembly structure for a modified wiper bar 86′. In this modification, the wedge 150, pad 151, and cover 152 are the same as in Fig. 2C. At the lower margin of the pad assembly, a flat bar 154 extends along the full length of the outside of the cover. Another bar 155 of a generally T-shaped cross-section extends along the full length of the inner side of the pad 151. The bars 154 and 155 and the pad 151 and cover 152 are first fastened together as an assembly by a plurality of spaced screws 154a. The wiper bar 86′ is provided with recesses interfitting with the bar 155 for receiving that bar with a sliding fit. The entire assembly may be inserted endwise in or removed endwise from the wiper bar 86′ from the front side of the press (as viewed in Fig. 10) after the auxiliary carriage 30 has been moved to its retracted position so as to bring the wiper bar 86′ into an accessible location. The upper margin of the cover 152 is clamped to the bar 156 after the assembly is inserted. The pad assembly shown in Fig. 18 is capable of easier replacement and maintenance than the conventional one shown in

Fig. 2C.

LOCKING MECHANISM–FIGS. 19–21

These figures illustrate the locking mechanism by which the carriage 3 and main frame 1 are locked together with the carriage in its operating position, so that the relative positions of the carriage and the main frame are not disturbed by vibration, which may be due to the mechanism for reciprocating the web, or by any other cause. The upright members 1a and 1b of the main frame 1 have fixed thereon a plurality of tapered socket members 131, best seen in Fig. 21. The side frame members 3a and 3b of the carriage 3 have fixed thereon a corresponding plurality of tapered locating pins 132. When the carriage 3 is moved to its operating position, each of the pins 132 enters a corresponding socket 131. The pins and sockets thereby prevent lateral movement between the uprights 1a, 1b, and the side frame members 3a, 3b of the carriage 3.

The side frame members 1a and 1b each carry a pair of power operated locks 133. Each lock comprises a hydraulic cylinder 134 operating a piston rod connected to a tapered pin 135 which cooperates with a mating tapered socket 136 fixed on the frame 3a or 3b of the carriage 3. After the carriage 3 has been moved to its operating position, appropriate ends of the cylinders 134 are supplied with fluid under pressure, preferably simultaneously, to drive their respective pins 135 into their associated sockets 136, thereby preventing any movement of the carriage 3 away from the main frame 1. This locking of the carriage 3 against movement away from the main frame ensures that the locking pins 132 remain tightly engaged with their sockets 131, and ensures that the carriage 3 and main frame 1 are positively locked together against any relative movement, either lateral or longitudinal. The supply of fluid under pressure to all the cylinders 134 may be controlled by a single manually operated valve (not shown). The cylinders 134 are double-acting, and the locking pins 135 may be withdrawn from their respective sockets 136 only by supplying fluid under pressure to their opposite ends.

FIGS. 22–25
IMPRESSION CYLINDER DRIVE

The plate cylinder 4 is rotated by a motor (not shown), through gearing which may include a gear 162 fixed on a shaft 161 of the plate cylinder 4. The pressure cylinder 5 is driven from the gear 162 through a gear 163 and a resilient coupling generally indicated by the reference numeral 165, shown in Figs. 22–25, which connects the gear 163 to the shaft 164 of pressure cylinder 5.

The coupling 165 includes a hub 166 fixed on the shaft 164 and carrying a plate 166a on which are mounted four posts 167, extending outwardly from the plate (to the right in Fig. 22) and equally spaced near the periphery of the plate 166a. Gear 163 is rotatable on the shaft 164, outwardly of the plate. Fixed on the gear 163 is a second set of four inwardly extending posts 170. Each post 167 has adjustably mounted thereon a spring retainer 172, facing an adjacent spring retainer 171. A spring 173 is held in compression between each facing pair of retainers 171 and 172. The position of spring retainer 172 is adjustable by means of a screw 174, whose position may be locked by means of a set screw 175.

When the cylinders 4 and 5 are rotating and not in pressure contact, the torque for driving cylinder 5 is transmitted through gears 162 and 163, posts 170, springs 173, posts 167 and hub 166 to the shaft of cylinder 5.

The plate cylinder 4 has an external surface consisting of a printing plate, supported by the rigid cylinder. The structure of the pressure cylinder is similar, except that there are several peripheral layers, all of which are of compressible material. The printing plate may have minor variations in thickness, within prescribed tolerance limits. The layers on the pressure cylinder are also subject to variations in thickness, because of the tolerances permitted in constructing the layers. The diameter of the cylinders 4 and 5 may therefore not be constant throughout the pripheries of those cylinders. Furthermore, they may vary from one press run to another, as the make up of the two cylinders is changed.

When the cylinders 4 and 5 have their surfaces in contact, there is a very strong force holding those cylinders in rolling engagement. Because of the dimensional differences in the diameters, as mentioned above, this force may vary as the cylinders turn. Furthermore, the line of contact between the cylinders may shift during printing to an angular position different from the angular cylinder position which that line would occupy if its locations were solely determined by the driving gears. This conflict between the line of contact position determined by the rolling engagement and the line of contact position determined by the gears may cause a sliding of one cylinder relative to the other with resultant blurring of the printed lines or dots. In order to prevent any sliding movement of one cylinder relative to the other while they are in printing contact, it is desirable to let the rolling engagement of the cylinders control their angular positions rather than having their angular positions forcibly determined by the driving gears.

The resilient coupling 165 allows the pressure cylinder 5 to roll freely by virtue of its contact with the plate cylinder 4. When the cylinder 5 goes on pressure, i.e., when it engages the leading edge of the printing plate

on the cylinder 4, that cylinder may move slightly backward with respect to the plate cylinder 4. In other words, looking at Fig. 23, the posts 167 on the hub 166 may move slightly counterclockwise with respect to the posts 170, so that springs 173 are compressed, and the drive from the posts 170 is completely through the springs 173. As long as the pressure cylinder 5 remains in rolling contact with the plate cylinder 4, the springs remain compressed beyond their unloaded position, and compensate, by varying their compression, any uneven diametrical dimensions of the cylinders. There is thus no sliding between the cylinders.

When the pressure cylinder 5 comes to the end of the plate 4, the pressure between the two cylinders is relieved. The compressed springs 173 are unopposed, and move the posts 167 in a clockwise direction with respect to the posts 170, as viewed in Fig. 23. This clockwise movement is limited by a stop screw 174 fixed in one of the posts 170. The head of the screw 174 abuts against an adjacent post 167 when the pressure cylinder 5 is moving under light load. Only one such stop screw 174 is required, since almost all the torque is transmitted through the gears 162 and 163.

A stop pin 176 is fixed on the plate 166a, and is in the path of an extension 170a on one of the posts 170. The stop pin 176 and extension 170a limit the backward movement of pressure cylinder 5 with respect to the plate cylinder 4.

FIG. 1

This figure includes, besides the press itself, auxiliary equipment including a sheet feeder 7 and a sheet delivery mechanism 8. That equipment is conventional, and is described here only for the sake of completeness.

The sheet feeder 7 includes a sheet supplier 171 which delivers sheets to a conveyor 172. Conveyor 172 carries the sheets to a transfer cylinder 173 which transfers them to the pressure cylinder 5. Printed sheets are picked up from the pressure cylinder by a conveyor 174 and are carried back over the sheet supply mechanism 7 to a stacker 175. The stacker 175 may be provided with a board inserting mechanism 176, which periodically supplies a sheet or board of heavy material such as plywood or Masonite, to the stacker 175. The boards are effective to limit the number of sheets assembled in a single stack, thereby limiting the pressure on any sheet due to the sheets stacked above it, and reducing the possibility of transfer of the freshly printed ink between the adjacent sheets.

CLAIMS

1. A banknote intaglio printing press, comprising:
   a. a plate cylinder (4);
   b. intaglio plate means (9) on the cylinder having ink-receiving recesses (9a) separated by smooth surfaces (96), said plate means extending around less than the entire periphery of the cylinder and having its peripheral ends separated by a gap;
   c. means (11) for applying ink over the smooth surfaces and the recesses; and
   d. wiping means (81, 90, 86, 110, 111, 114, 85, 87, 100) for wiping the smooth surfaces of the plate means, including:
      1. a supply reel (81) for a web for engaging the plate means in wiping contact;
      2. a take-up reel (90), for the web;
      3. a wiping bar (86);
      4. means (110, 111, 114) for supporting the bar adjacent the cylinder;
      5. means (85, 89, 87) defining a path for the web from the supply reel, between the bar and the cylinder, and thence to the take-up reel; and
      6. means (100) for advancing the web during the intervals when the bar is adjacent the gap; and
   e. a carriage (3) supporting the wiping means and rollable along an underlying surface between an active position in which the web when present may be held by the bar in engagement with the plate means and a retracted position in which the web is spaced from the plate means.

2. A printing press as in claim 1, including:
   a. means (115, 116, 118, 120, 122) on the carriage for reciprocating the web laterally to assist the wiping action thereof;
   b. a main frame (1) supporting said plate cylinder; and
   c. means (131, 132) for locking the carriage to the main frame when the carriage is in its active position, to prevent relative movement between the carriage and the main frame.

3. A printing press as in claim 1, including:
   a. means (124, 145) for adjusting the pressure of the bar against the plate cylinder;
   b. a main frame (1) supporting the plate cylinder; and
   c. means (133, 135, 136) for locking the carriage against movement away from the main frame when the carriage is in its active position.

4. A printing press as in claim 1, including:
   a. a main frame (1) supporting the cylinder;
   b. locating pin means for holding the carriage in its active position against lateral movement with respect to the main frame; and
   c. locking means to hold the carriage

against movement away from the main frame.

5. A banknote intaglio printing press substantially as hereinbefore described with reference to the accompanying drawings.

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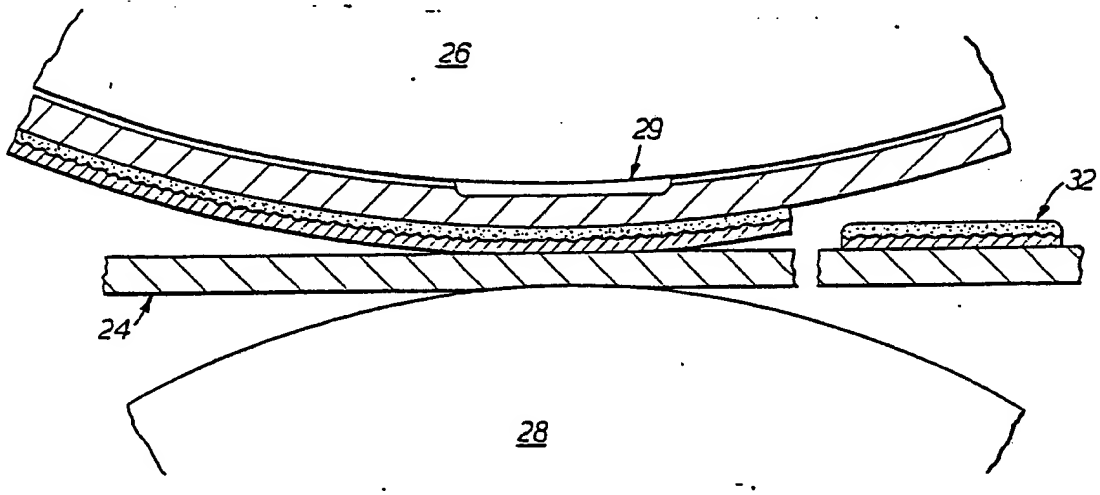

(57) Abstract

A security token, such as a bank note or identity card, which is durable and difficult to forge. The token comprises a sheet-like substrate made up from a film of transparent bi-axially oriented polymer coated with layers of opaque and heat-activated adhesive material. The opaque layer is applied in such a way as to leave a transparent area for inspection of a security device, e.g. a diffraction grating, incorporated in the polymer film. The substrate may bear printed or other identifying indicia and is protected with an intimately bonded layer of transparent polymeric material.

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TITLE:

'IMPROVED BANKNOTES AND THE LIKE'

TECHNICAL FIELD

This invention relates to the design, construction and production of paper-like "security tokens" such as bank-notes, travellers cheques, share script, personal identification papers and the like. It seeks to provide a durable token of high security, that is, one which is most difficult to forge.

BACKGROUND ART

In our prior Australian Patent No.488,652, a novel approach to the production of security tokens - particularly bank-notes - was disclosed and the serious problems which confront conventional bank notes with respect to forgery were described. The security token or bank-note disclosed in Patent No.488,652 comprised a substrate of opaque thermoplastic sheet material intimately bonded to a web of woven or unwoven thermoplastic fibres, the substrate being printed as desired and having bonded thereon one or more optically-variable security devices. The fibrous web was employed to impart durability, crumple-resistance and

tear-strength to the note. Where a security device (such as a Moire pattern) was employed which depended for its optically variable properties upon the transmission of light, it was necessary to punch out a hole in the substrate, insert the device and bond it in place with further layers of (transparent) plastic sheet material.

Although samples of bank-notes formed in this way performed most satisfactorily with respect to conventional notes regarding durability and security, they were complex and relatively expensive. Moreover, when transmission security devices were inserted in pockets in the substrate, an area of weakness and high stress was created which reduced both durability and security.

DISCLOSURE OF THE INVENTION

It has now been found that tokens such as bank-notes can be produced with the durability and security of those described in our prior patent No.488,652 without the complication and expense of the central fibrous web and without necessitating the damaging discontinuity previously required when transmission security tokens were employed.

It will be appreciated that the vulnerability of conventional bank-notes to forging has come about because of the great advances which have been made in the technologies of paper-making, printing and photo-engraving. The approach to this problem adopted by the present invention, like that of our Australian Patent No.488,652, is based upon the

difficulty of simulating optically-variable devices by photo-engraving techniques.

Accordingly, the bank-note (or other security token) of the present invention comprises a thin, sheet-like substrate bearing printed or other identifying indicia and at least one optically-variable security device, characterised in that the substrate comprises a transparent, bi-axially-oriented polymeric film composite having a heat-activated adhesive coating and an opacifying coating and characterised in that said substrate, indicia and optically variable device are covered with a transparent protective layer of polymeric material intimately bonded to the substrate.

The use of an optically-variable device may not be essential, but the substrate may comprise a laminate of two or more layers of transparent bi-axially-oriented polymer film, each of which is coated on both sides with a heat activated adhesive layer. Alternatively, the substrate could be a suitable single-layer film should such become available in commercial quantities. Preferably, this substrate is coated on both sides with an opacifying pigmentary coating, comprising a major portion of pigment in a minor proportion of a cross-linked polymeric binder, the coating being applied so as to leave at least one transparent area within the film within which the optically variable device may be placed. It is also preferable to hot-stamp the optically

variable device in position on the composite substrate, to print both sides of the substrate and to cover both sides with a transparent protective layer, all the components of the bank-note or other security token thus formed being intimately bonded together. (It is possible, of course, to apply the device before or after printing).

It will be appreciated that some notes or tokens of low nominal value may need not to include an optically variable device. Such notes are also intended to be within the scope of the present invention, however, the use of optically variable devices is prefered - as is their application on the note within transparent areas to allow them to be viewed from either side of the note and to allow optical-transmission effects - such as Moire gratings - to be employed. Optically variable devices comprising Moire patterns and diffraction gratings were described in our above-mentioned prior Australian patent.

The invention also comprises a method of producing a bank-note or the like security token comprising the basic steps of forming a composite, transparent, polymeric substrate by heat-laminating at least two films of adhesive-coated, bi-axially-oriented polymer material together and by coating at least one surface of the composite sheet with an opacifying treatment including a major proportion of one or more pigmentary materials bound with a minor proportion of a heat-activated cross-linkable

polymeric binder, passing said substrate through a printing machine to print indicia on said opacifying coating, hotstamping at least one optically variable device onto the substrate (either before or after printing, but preferably after) and then coating both sides of the printed substrate with a transparent protective layer of polymer material.

In order to minimise the discontinuity associated with the inclusion of a security device within the bank-note or the like token, the substrate is typically between 60 and 80 microns thick, while the optically variable security devices may be between 2 and 8 microns thick. Such devices may be formed in accordance with our co-pending patent Australian Patent Application Nos. PF0384 and PF0386. To handle such devices, it is necessary that they be carried on a transfer foil, it being preferred in accordance with the present invention, to transfer these devices from the foil onto the substrate by a hot-stamping process. Also, it will be clear from the aforementioned co-pending patent application that the security devices need not be formed as discrete entities on the transfer foil but may, with advantage, be formed as a continuous optically variable coating on the foil, portions of which may be transferred onto the substrate at predetermined locations thereon.

Accordingly, the invention also includes apparatus for producing bank-notes and the like security tokens comprising:

means for feeding a printed sheet of polymeric substrate (of the type described) through the nip of a pair of rollers;

means for also feeding a transfer foil having a thin coating of optically variable material thereon through said nip together with said substrate so that said coating is adjacent to the substrate;

raised pads on the surface of one of said rollers adapted to be heated so that, when one of said pads is brought into contact with said foil (or with the substrate) portion of the coating is transferred to the substrate; and

index means adapted to sense the position of the substrate and to delay or advance the rotation of said one roller so as to position said pads (and said coating portion) so that said pads press upon predetermined areas of the substrate to transfer said portions of the coating thereto.

In order to further portray the nature of the present invention, a particular embodiment thereof will now be described by way of example and illustration only. In the following description reference will be made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a diagrammatic representation of a laminating coating and drying process and apparatus suitable for the production of a bank-note substrate.

Figure 2 is a diagrammatic representation of apparatus for transferring optically variable devices from a transfer foil onto the substrate of the particular embodiment.

Figure 3 is a detailed cross-sectional diagram showing the substrate and the transfer foil of Figure 2 in more detail.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

The particular embodiment of this invention concerns the production of bank-notes of high durability and security but which can be readily mass-produced. The bank-note of this particular embodiment is to have the appearance and feel of a conventional paper bank-note except that it includes a transparent portion or window within which an optically variable device such as a Moire grating or a diffraction grating is incorporated. In spite of the incorporation of this device, however, the note - at least superficially -is to appear to be of uniform thickness, to have no discontinuities, stiff inserts or the like. As previously indicated, the note basically comprises a transparent substrate having a pigmented coating, leaving the window onto the surface of which a very thin flexible optically variable device is hot-stamped. The entire note is then covered on each side with a thin, transparent protective polymeric coating adapted to resist dirt, grease and common solvents and to protect the exposed surface of the window and the exposed surface of the optically variable device.

Referring now particularly to Figure 1 of the accompanying drawings, the production of the basic substrate material as a continuous strip or web is shown diagrammatically. The substrate illustrated consists basically of a laminate of three 24 micron sheets, 10, 12 and 14 of polymeric film on each side of which a thin coating of heat-activated polyolefin has been deposited. The three sheets are led together through a pair of heated callender rolls 16 so as to form them into an intimately bonded laminate 18. This laminate is led through a double set of printing rolls 20 which apply a uniform coating of a pale-coloured printing ink onto both surfaces of the laminate 18 to form the substrate 24, which is led through a drying oven 22 within which the coating is dried and cured.

Preferably, prior to the coating step, the laminate 18 is subjected to known surface treatment to improve the adhesion of the opacifying ink thereto. A suitable treatment may be the use of corona discharge, this being illustrated diagrammatically at 25 in Figure 1. The treated laminate is coated with a pigmented coating comprising a pigment such as titanium dioxide dispersed within a binder or carrier of heat-activated cross-linkable polymeric material. In the coating of the substrate at station 20, a transparent window is left at intervals corresponding to each note within which the security device will be later inserted.

After the substrate has been produced as described in respect to Figure 1, it is printed by the high quality presses normally employed in the production of bank-notes. Where sheet fed presses are employed, the substrate web may be cut into sheets for feeding, otherwise it can be fed directly into web fed presses.

After printing, the web or sheets are fed through an apparatus manufactured in accordance with the present invention wherein the optically variable devices are hot-stamped onto the window portion of the partially completed bank-notes. In this particular embodiment, the printed sheets or web 24 are fed between the nip of a pair of rollers 26 and 28 together with (and at the same speed as) a transfer foil 30. It would be usual for the sheet or web 24 to have a plurality of bank-notes printed across its width but, in that case, it can be readily arranged for the transparent windows of the notes in each row to be precisely aligned transversely across the sheet or web. Thus, a separate transfer foil 30 is provided for each note across the width of the sheet.

In accordance with the invention, upper roll 26 bears on its surface a series of raised pads 29 in line with each transfer foil 30, the pads 29 being spaced apart by a linear distance corresponding exactly with the longitudinal interval between the windows of the printed notes on sheet 24. Either the entire upper roll 26 or the individual

raised pads 29 are heated so that as they rotate, they press the transfer foil firmly against the sheets 24 to effect the transfer of an optically variable device from the surface of the foil onto the sheet. Details of the transfer foil are provided in our above-mentioned co-pending application, but Figure 3 provides illustration of this. In this example, the optically variable device 32 consists of a 3 to 5 micron layer of a soft thermoplastic material such as an acrylic copolymer into the surface of which a diffraction grating has been impressed and onto which surface a thin coating (less than 1 micron) of aluminium has been deposited to form the reflective diffraction grating. On this metallised surface, a further layer of an acrylic copolymer has been deposited as a heat-activated transfer medium which will facilitate the transfer and adhesion of the thin composite foil from the carrier and onto the substrate. To facilitate this transfer, the roller 28 is preferably cooled.

While transverse alignment of the notes printed on sheet 24 can be achieved by appropriate guides and accurate trimming of the sheets, longitudinal registration of the transfer devices within the window requires adjustment to compensate for stretch in a continuous web or slight variations in the pickup of separate sheets. For this purpose, in accordance with the present invention, a detector 34 is provided to detect a series of registration marks printed or otherwise formed on the edge of sheet 24,

these marks bearing a constant positional relationship with the transparent windows of the printed notes. The output from detector 34 is transmitted to a comparator/controller 36 into which a signal is fed from a shaft-position encoder 38 connected to the shaft of roller 26, the comparator being adapted to produce a signal to indicate the degree of alignment or misalignment between pads 29 and the windows of the notes. This signal from the comparator can then be deployed to drive motor 40 to adjust the angular position of the roller 26 appropriately to maintain the desired alignment.

Finally, the printed note in sheet or roll form, bearing the optically variable devices, are then subjected to a further calendering or coating process (not illustrated) in which a thin coating of protective and transparent polymeric material is applied to both surfaces of the sheets, this coating serving the combined purpose of providing a soil and solvent resistent outer skin and of bonding the optically variable devices firmly in place and protecting their surfaces from mechanical damage. After this final coating operation, the completed bank-notes are separated by guillotining in the conventional fashion.

INDUSTRIAL APPLICABILITY

It will be appreciated by those skilled in the art that a durable, and secure bank-note, capable of mass production at economical cost by note issue authorities may be produced

by the apparatus and process described in the particular embodiment given. However, many variations and modifications can be made to the system as described without departing from the scope of the present invention.

Claims

1. A bank note or other security token comprising a thin sheet-like substrate bearing printed or other identifying indicia and including some security marking or device, characterised in that the substrate comprises a transparent bi-axially-oriented polymeric film composite having a heat-activated adhesive coating and an opacifying coating and characterised in that said substrate, indicia and the security marking or device are covered with a transparent protective layer of polymeric material intimately heat-bonded to the substrate.

2. A bank note or the like according to claim 1 further characterised in that the substrate itself comprises a laminate of two or more layers of transparent bi-axially-oriented polymer film each of which is coated on each side with a heat-activated adhesive layer.

3. A bank note or the like according to claim 1 or 2 further characterised in that said opacifying coating is applied to both sides of the substrate and comprises a major proportion of pigment and a minor proportion of a cross-linked polymeric binder.

4. A bank note or the like according to any preceding claim further characterised in that the opacifying coating is applied so as to leave an area of the substrate uncoated and transparent.

5. A bank note or the like according to claim 4 characterised in that a security device comprises an optically variable device heat-bonded to the substrate in said transparent area.

6. A method of producing a bank note or like security token comprising the basic steps of forming a composite, transparent optically variable device heat-bonded to the substrate in said transparent area.

7. A method of producing a bank note or like security token comprising the basic steps of forming a composite, transparent polymeric substrate by heat laminating at least two films of adhesive-coated, bi-axially-oriented polymer material together and by coating at least one surface of the composite sheet so formed with an opacifying layer including a major proportion of one or more pigmentary materials bound with a minor proportion of a heat-activated cross-linkable polymeric binder, printing indicia on said opacifying coating, hot stamping at least one optically variable device onto the substrate (either before or after printing) and then coating both sides of the printed substrate with a transparent protective layer of polymer material.

8. A method according to claim 6 characterised in that the optically variable devices are conveyed into position over the substrate by and on a transfer foil and transferred from the foil onto the substrate by hot-stamping, the opacifying coating being applied to leave an uncoated and transparent area on the substrate and the optically variable devices being applied by hot-stamping onto that area.

9. Apparatus for producing bank notes and the like thin, security tokens comprising:

means for feeding a printed sheet (24) of polymeric substrate (of the type described) to the nip of the pair of rollers (28) and (28);

means for also feeding a transfer foil (30) having a thin coating of optically variable material thereon through said nip together with said substrate so that said coating is adjacent to the substrate;

raised pads (29) on the surface of one of said rollers adapted to be heated so that, when one of said pads is brought into contact with said foil (or with the substrate) portion of the coating is transferred to the substrate; and

detecting means (34) adapted to sense the position of the substrate and to delay or advance the rotation of the said one roller so as to position said pads (and said coating portion) so that said pads press upon pre-determined areas of the substrate to transfer said portion of the coating thereto.

10. A bank note, security token or the like substantially as hereinbefore described with respect to the accompanying drawings.

11. A method of producing a bank note security token or the like substantially as hereinbefore described with reference to the accompanying drawings.

12. Apparatus for manufacturing bank notes security tokens or the like substantially as hereinbefore described with reference to the accompanying drawings.

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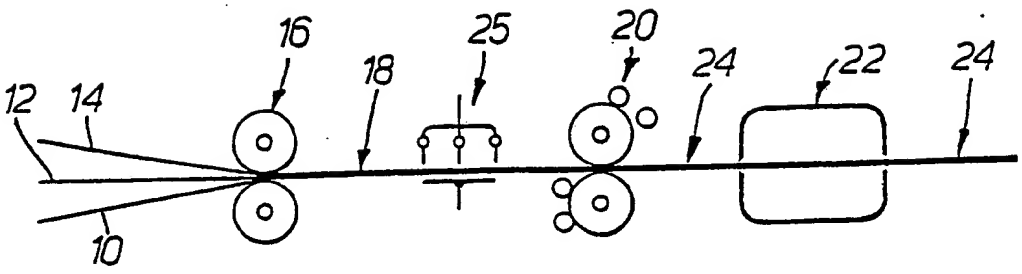

FIG. 1.

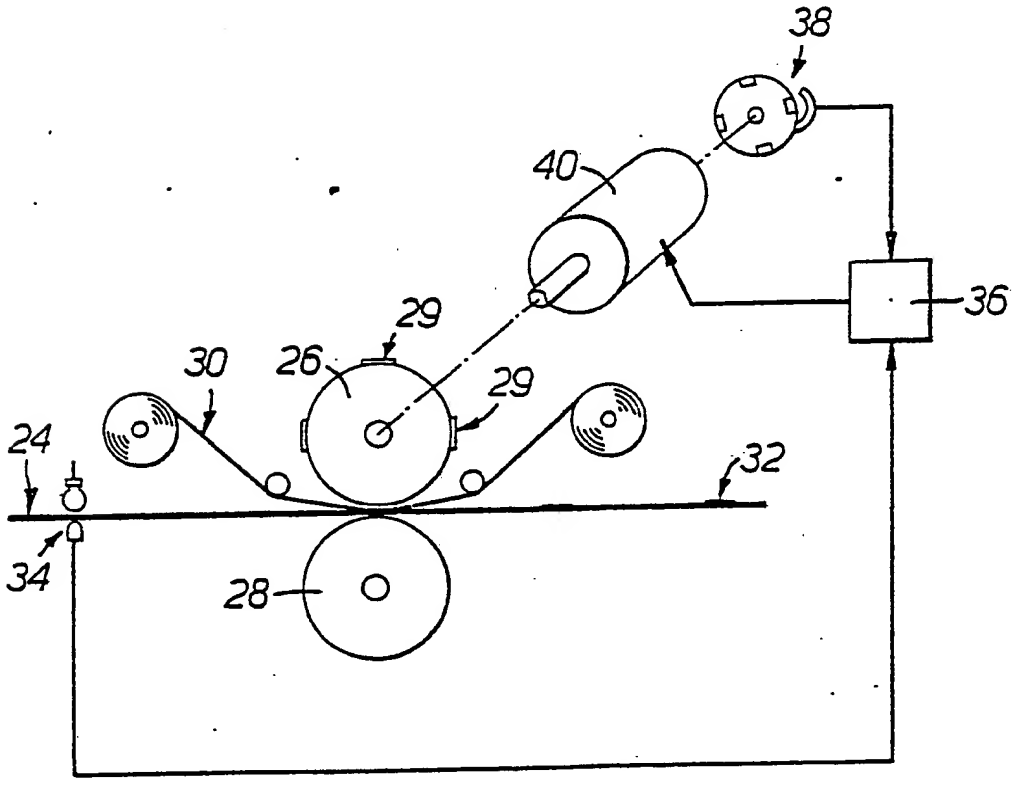

FIG. 2.

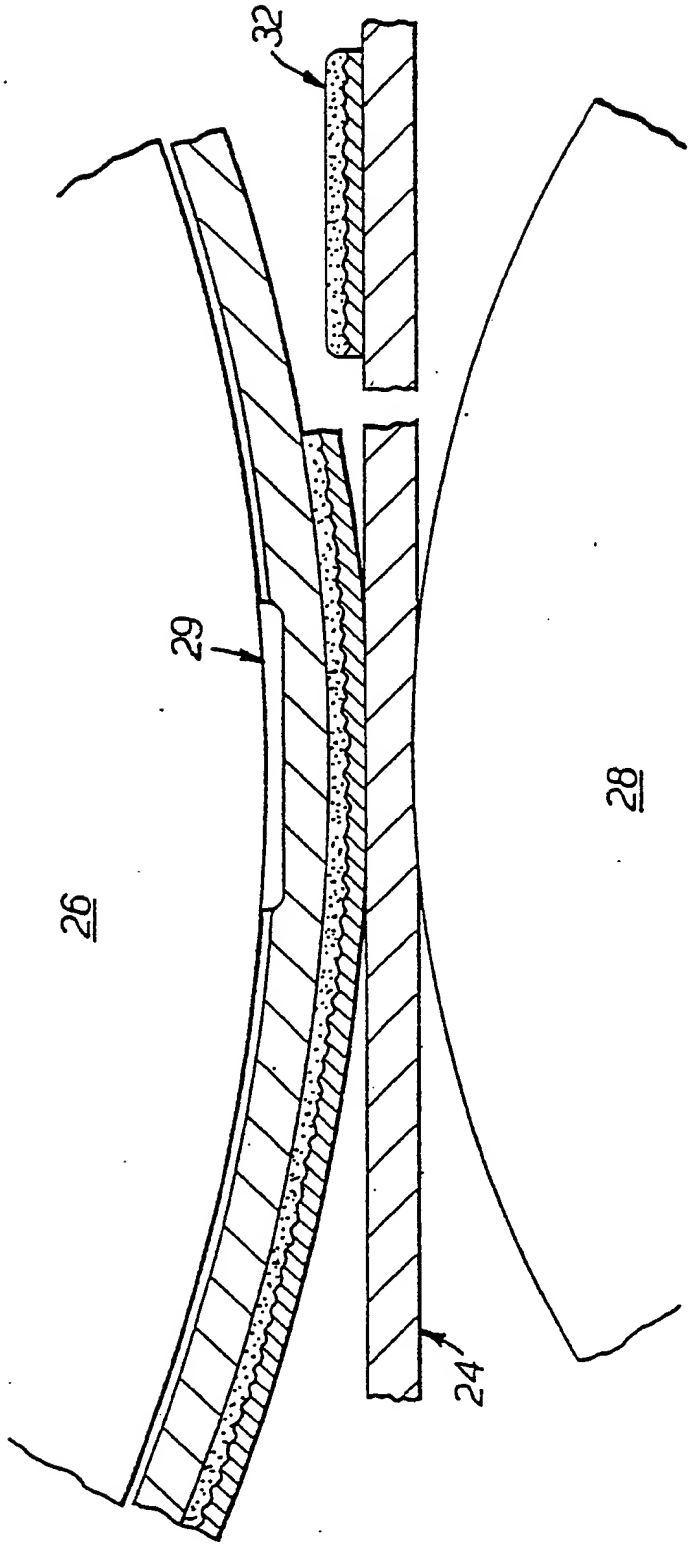

FIG. 3.